SPECIFIC REQUIREMENT'S (Section- Project)
C/ENGG/SPEC/SEC-PROJECT/SPECIFIC REQUIREMENT REV NO 10

Employer has standardized its Specific Requirement for various equipment and works for different voltage levels. Items or clauses, which are not applicable for the scope of this package as per schedule of quantities described in BPS or as per scope defined elsewhere in Section Project, the technical specification/clauses for the items specified below should not be referred to.

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
A.	**Section: GTR Rev 15**	
1.	Clause 2.1 (a)	"All equipment/materials/items, as per **Annexure-K (Rev 01),** as applicable under present scope of works, shall be procured and supplied from domestic manufacturers only with Minimum Local Content for individual items as listed in the above annexure. Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the contractor. The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract."
2.	New Clause no 2.1 C	Equipment/Material/Items from a Indian manufacture who have specified transfer of technology (TOT) arrangement with an entity from a country which shares land border with India shall be accepted only if the Indian Manufacturer is complying the requirement of prevailing Guideline by Government of India under Rule 144(xi) of the General financial Rule (GFR) 2017
3.	New Clause No. 4.7	**Planning and Designing in purview of Vulnerability Atlas of India** Vulnerability Atlas of India (VAI) is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT wise hazard, maps with respect to earthquakes, winds and floods for district wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation stage. This Atlas is one of its kind single point source for the various stakeholders including policy makers, administrators, municipal commissioners, urban managers, engineers, architects, planners, public etc. to ascertain proneness of any city/ location/ site to multi-hazard which includes earthquakes, winds, floods thunderstorms, cyclones and landslides. While project formulation, approvals and implementation of various urban housing, buildings and infrastructures schemes, this Atlas provides necessary information for risk analysis and hazard assessment. The Vulnerability Atlas of India has been prepared by Building Materials and Technology Promotion Council under Ministry of Housing and Urban Affairs, Government of India and available at their website https://www.bmtpc.org/. It is mandatory for the bidders to refer Vulnerability Atlas of India for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning and designing the project in terms of: i) Seismic zone for earthquakes, ii) Wind velocity iii) Area liable to floods and Probable max. surge height iv) Thunderstorms history v) Number of cyclonic storms/ severe cyclonic storms and max sustained wind specific to coastal Region vi) Landslides incidences with Annual rainfall normal vii) District wise Probable Max. Precipitation
4.	New Clause No. 8.3	**8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE** 8.3.1 Contractor shall procure bought out items from sub-vendors as per the list in "Compendium of Vendors" available on POWERGRID web-site www.powergrid.in after ensuring compliance to the requirements/conditions mentioned therein. Contractor shall explore first the possibilities of procuring the bought out items from POWERGRID approved existing vendors. In case of their unavailability / non-response, Contractor may approach POWERGRID for additional sub-vendor approval. In that case, the assessment report of

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		proposed sub vendor by Contractor along with the enclosures as per **Annexure-F Rev 01** shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Contractor's proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, It is the responsibility of the Contractor that Project activities do not suffer on account of delay in approval/non approval of a new sub-vendor. For Telecom/GA&C packages, the makes/model of small items shall be finalized during approval of DRS by Telecom/GA&C department. The responsibility and the basis of inspection for various items & equipment is placed at **Annexure-G Rev 01** along with the requirement of MQP (Manufacturing Quality Plan), ITP(Inspection & Test Plan), FAT(Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item. Contractor shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order. A Copy of MQP format is placed at **Revised Annexure – M.** Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/ POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian / International standards. **Inspection Levels:** For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below: **Level –I:** Contractor to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers. **Level – II:** Contractor to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Contractor and CIP/MICC will be issued by POWERGRID. Else, Contractor would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports / certificates. **Level - III:** Contractor to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Contractor and CIP will be issued by POWERGRID. Else, Contractor would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID. **Level – IV:** Contractor to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID. 8.3.2 Contractor shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Contractor shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP). 8.3.3 The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Contractor shall obtain for the Employer and for his duly authorized representative permission

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		to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations. 8.3.4 Contractor shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor within 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board. 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point(CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Contractor's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Contractor shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports. 8.3.6 Contractor shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Contractor offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule. 8.3.7 Contractor shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works. 8.3.8 Contractor shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection. 8.3.9 Contractor shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch . 8.3.10 The Employer or IE shall give notice in writing to the Contractor, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract. 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission. 8.3.12 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspection Engineer(IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Contractor/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/IE. Contractor shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE to issue such a certificate shall not prevent the Contractor from

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.
		8.3.13 In all cases, where the Contract provides for tests whether at the premises or works of the Contractor or of any Sub- Contractor, the Contractor, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspection Engineer or to his authorized representative to accomplish testing.
		8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.
		8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
		8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
		8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Contractor shall submit Joint Inspection Report of equipment under Re-Work/Re-Engineering along with procedure for the same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
		8.3.18 Contractor may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
		8.3.19 Contractor shall ensure that all possible steps are taken to avoid damage to the equipment during transport, storage and erection.
		8.3.20 Contractor shall implement additional stringent quality checks and preparation during installation of GIS at site (if applicable) as per POWERGRID approved guidelines/Technical specifications.
		8.3.21 Contractor shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable
		8.3.22 For EHV transformers/reactors: Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Contractor to ensure that windings for Transformer/Reactors are made in air-conditioned environment. Core-coil assembly shall be performed in positive pressurized dust-controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Contractor shall ensure that respective civil foundations & Fire walls for Transformer/Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer/Reactors units. All the requisite material for Neutral & Delta Bus formation required for charging of complete bank of 765KV class 1-ph Transformer/Reactor units shall be made available at the concerned sites before receipt of the Transformer/Reactor units at site
		8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work based on performance of Contractor/sub Contractor
		8.3.24 Contractor/sub-vendor, who has more than one contract running concurrently for supply of material of same design and specification from the same factory, may propose to offer material in a single lot. No deduction from payments on account of call combination shall be made to the Contractor. However, POWERGRID reserves the right to carry out call combination as per requirement and decision of POWERGRID shall be final in this regard
		8.3.25 Unless specified otherwise, inspection shall be made at the place of manufacturer prior to dispatch and shall be conducted so as not to interfere unnecessarily with the operation of the work

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>8.3.26 Should any item being supplied be found not to comply with the supplied design, it shall be liable to rejection. No item once rejected shall be resubmitted for inspection, except in cases where the Employer or his authorized representative considers that the defects can be rectified. All rejected material shall be disposed-off/destroyed under intimation to Employer QA&I representative as per laid down procedures.
8.3.27 The specified grade and quality of material from approved source shall be used by the Contractor. To ascertain the quality of material used, the inspector may at his discretion get the material tested at an approved laboratory.</td></tr>
<tr><td>5.</td><td>Clause no. 9.2</td><td>The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID/representative authorized by POWERGRID/representative of Utility /representative of accredited test lab/ representative of The National Accreditation Board for Certification Bodies (NABCB) certified agency shall also be acceptable.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within the years specified below from the date of NOA. In case the test reports are of the test conducted earlier than the years specified below from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer:-

<table>
<tr><th>S. No.</th><th>Name of Equipment</th><th>Validity of type test(in years)</th></tr>
<tr><td>1</td><td>Power Transformer</td><td>5</td></tr>
<tr><td>2</td><td>LT Transformer</td><td>5</td></tr>
<tr><td>3</td><td>Shunt Reactor</td><td>5</td></tr>
<tr><td>4</td><td>OLTC</td><td>10</td></tr>
<tr><td>5</td><td>Bushing of Power Transformers/Reactors</td><td>7</td></tr>
<tr><td>6</td><td>Fittings and accessories for Power transformers & Reactors</td><td>10</td></tr>
<tr><td>7</td><td>Circuit Breaker</td><td>10</td></tr>
<tr><td>8</td><td>Isolator</td><td>10</td></tr>
<tr><td>9</td><td>Lighting Arrester</td><td>10</td></tr>
<tr><td>10</td><td>Wave Trap</td><td>10</td></tr>
<tr><td>11</td><td>Instrument transformer</td><td>10</td></tr>
<tr><td>12</td><td>GIS & Hybrid GIS</td><td>15</td></tr>
<tr><td>13</td><td>LT Switchgear</td><td>10</td></tr>
<tr><td>14</td><td>Cable and associated accessories</td><td>10</td></tr>
<tr><td>15</td><td>Relays</td><td>7</td></tr>
<tr><td>16</td><td>Capacitors</td><td>10</td></tr>
<tr><td>17</td><td>Battery and Battery charger</td><td>10</td></tr>
<tr><td>18</td><td>Conductor & Earth wire</td><td>10</td></tr>
<tr><td>19</td><td>Insulators (Porcelain/Glass)</td><td>10</td></tr>
<tr><td>20</td><td>Composite Insulators</td><td>5</td></tr>
<tr><td>21</td><td>PLCC</td><td>5</td></tr>
</table>

Note:- For all other equipment’s validity of type test shall be 10 years from date of NOA.
Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

The Contractor shall intimate the Employer the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.</td></tr>
<tr><td>6.</td><td>Clause No.12.3.6 S.No.4</td><td>
<table>
<tr><td>S.No.</td><td>PIPE LINE</td><td>Base colour</td><td>Band colour</td></tr>
<tr><td>4</td><td>Pylon support pipes</td><td>BLACK</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>7.</td><td>Clause No. 14.4</td><td>CCTV system for Construction Monitoring for Substation/STATCOM Packages – To be provided by the contractor</td></tr>
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<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>The scope of work shall include “Establishment of CCTV System for Construction Monitoring” of entire switchyard (herein after called CCTV). The contractor shall establish CCTV, atleast 5 days prior to commencement of Construction activities at site. CCTV system shall comprise of PTZ cameras alongwith associated accessories (such as tubular poles, NVR , 6 port POE Switch, 9U Rack -Floor or wall mounted, Cat 6 cable, Power Cabling, Clamps & Connectors, etc. as per requirement) as per details mentioned below :
<table>
<tr><th>S. No.</th><th>Switchyard Type</th><th>Qty of PTZ Cameras</th></tr>
<tr><td></td><td>BOQ for PTZ cameras for CCTV system</td><td></td></tr>
<tr><td>1</td><td>765kV Switchyard (New)</td><td>4 Nos.</td></tr>
<tr><td>2</td><td>765kV Switchyard (Extn)</td><td>2 Nos.</td></tr>
<tr><td>3</td><td>400kV Switchyard (New/Extn)</td><td>2 Nos.</td></tr>
<tr><td>4</td><td>220kV Switchyard (New/Extn)</td><td>2 Nos.</td></tr>
<tr><td>5</td><td>132kV Switchyard (New/Extn)</td><td>1 No.</td></tr>
<tr><td>6</td><td>STATCOM yard</td><td>1 No.</td></tr>
</table>
Above equipment's shall be supplied as per technical specifications attached as Annexure-N. Power Supply arrangement including associated cabling works for above CCTV is to be arranged by the contractor. Further, UPS (including batteries) with minimum 3 hours of backup to ensure continuous working of CCTV system in case of power failure shall also be arranged by the contractor. Internet connectivity required for uploading CCTV feed to the portal/application shall be provided by POWERGRID.

Location of PTZ cameras shall be finalised in consultation with POWERGRID site In-charge. Further, during construction stage if any obstructions/constraints is faced in view of installed cameras, location of cameras shall be suitably modified by the contractor in consultation with POWERGRID site In-charge.

Upon completion of the project i.e. issuance of TOC, aforesaid CCTV system (along with all accessories) shall be dismantled and taken back by the contractor. However, all recordings shall be handed over to POWERGRID site.

The cost for establishing the aforesaid CCTV system is deemed to be included in the overall cost of the project and accordingly no later claims shall be entertained on this account</td></tr>
<tr><td>8.</td><td>Clause no 17.11.iv)</td><td>iv) Pull out Strength Test.</td></tr>
<tr><td>9.</td><td>Clause No 24.1</td><td>Technical requirements for 765/400/220/132kV* Air Insulated Switchgear (AIS) Equipment*:
A) Circuit Breaker
(i) The manufacturer(s) whose 765/400/220/132kV* Circuit Breaker(s) are offered, must have, manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 715/345/220/132kV* or higher voltage class Circuit Breaker(s), which are in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India for the offered Circuit Breaker and not meeting the requirement stipulated in (i) above, can also be considered provided that</td></tr>
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S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		a) 715/345/220/132kV* or higher Voltage class Circuit Breaker(s) must have been manufactured in the above Indian works & type tested (as per IEC/IS standard) and supplied as on the date of NOA. b) In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two (2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered Circuit Breaker(s) to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the Circuit Breaker(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor. **B) Isolator, Current Transformer, Capacitive Voltage transformer, Inductive Voltage transformer, Surge Arrester and Wave Trap)** (i) The manufacturer whose 765/400/220/132kV* equipment(s) are offered, must have manufactured, type tested (as per IS/IEC or equivalent standard) and supplied 715/345/220/132kV* or higher voltage class equipment(s), which are in satisfactory operation# for at least two (2) years as on the date of NOA. OR (ii) The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) and not meeting the requirement stipulated in (i) above, can also be considered provided that: a) 715/345/220/132kV* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on the date of NOA b) Manufacturer has manufactured, type tested (as per IS/IEC or equivalent standard) and supplied equipment(s) of 345kV or above voltage class (applicable for 765kV* Equipment)/220kV or above voltage class (applicable for 400kV* equipment) /132kV or above voltage class (applicable for 220kV* equipment) / 66kV or higher voltage class (applicable for 132kV* equipment), which are in satisfactory operation# for at least two (2) years as on the date of NOA. c) Warranty obligations for additional warranty of two (2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment(s) to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipment(s)* for the additional warranty period in addition to the contract Performance guarantee to be submitted by the contractor. OR (iii) The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) based on technological support of a parent company or collaborator and not meeting the requirement stipulated in (i) above, can also be considered provided that: a) 715/345/220/132kV* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on the date of NOA. b) The parent company or collaborator meets the qualifying requirements stipulated under (i) given above.

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply the 765/400/220/132kV* Air Insulated Switchgear (AIS) Equipment(s)* in India, shall be submitted. c) The parent company/collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor Legends: * : voltage class of respective equipment as applicable. # : satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark. NOA: Notification of Award
10.	Clause No 24.2	**Technical Requirement for 765kV class Transformer** (i) The Manufacturer whose 765kV Transformer(s) are offered must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Transformer of at least 500 MVA capacity or at least three (3) numbers 1-phase Transformers each having a capacity of at least 166 MVA, and the same transformer (s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) 715 kV or higher voltage class either One (1) no. 1-phase Transformer of at least 166 MVA capacity or One (1) no. 1-phase Reactor of at least 80 MVAR capacity must have been manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and same should have been supplied as on the date of NOA. b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 765kV transformer in India, shall be submitted. c) the collaborator shall furnish performance guarantee for an amount of 10**%** of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor
11.	Clause No 24.3	**Technical Requirement for 765kV class Reactor** (i) The Manufacturer whose 765kV Reactor(s) are offered must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Reactor of at least 110 MVAR capacity or at least three (3) numbers 1-phase Reactors each having a capacity of at least 36.7 MVAR and the same Reactor(s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA. OR The Manufacturer must have designed, manufactured, tested & supplied 715 kV or higher voltage class one (1) number 1-phase Transformer of at least 500 MVA capacity or at least three (3) numbers 1-phase Transformers each having a capacity of at least 166 MVA and the bidder should have designed, manufactured, tested & supplied 345 kV or higher voltage class one (1) number 3-phase Reactor of at least 50 MVAR capacity or at least three (3) numbers 1-phase Reactors each having a capacity of at least 16.7 MVAR and the same Transformer(s) & Reactor(s) should have been in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) 715 kV or higher voltage class either One (1) no. 1-phase Reactor of at least 80 MVAR capacity or One (1) no. 1-phase Transformer of at least 166 MVA capacity must have been manufactured in the above Indian works based on technological support of collaborator,

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>type tested (as per IEC/IS standard) and same should have been supplied as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply 765kV Reactor in India, shall be submitted.

c) the collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor</td></tr>
<tr><td>12.</td><td>Clause No 24.4</td><td>Technical Requirement for 400kV, 220kV, 132kV class Transformer

(i) The manufacturer whose transformer(s) are offered must have designed, manufactured, tested and supplied transformers as per table below:

<table>
<tr><td>345kV or above class 3-phase transformers of at least 200 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 66.7 MVA</td><td>applicable for supply of 400kV class Transformer</td></tr>
<tr><td>220kV or above class 3-phase transformers of at least 50 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 16.7 MVA</td><td>applicable for supply of 220kV class Transformer</td></tr>
<tr><td>commissioned 132kV or above class 3-phase transformers of at least 20 MVA or at least three (3) nos. 1-phase Transformers each having capacity of at least 6.7 MVA</td><td>applicable for supply of 132kV class Transformer</td></tr>
</table>
These Transformer(s) must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) 220kV (applicable for supply of 400kV class Transformer)/ 132kV (applicable for supply of 220kV class Transformer)/ 66kV (applicable for supply of 132kVclass Transformer)or higher voltage class transformers must have been designed, manufactured in the above Indian works based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 400kV/220kV/132kV* transformer in India, shall be submitted.

c) The collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor.</td></tr>
<tr><td>13.</td><td>Clause No 24.5</td><td>Technical Requirement for 400kV, 220kV and 132kV class Reactor

(i) The Manufacturer whose 400kV/220kV/132kV* Reactor(s) are offered must have designed, manufactured, tested & supplied Reactor as per table below:

<table>
<tr><td>345kVor above class 3-phase shunt reactor of at least 50 MVAR capacity or at least three (3) nos. 1-phase Shunt</td><td>applicable for supply of 400kV class Reactors</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Reactors, each having capacity of at least 16.7 MVAR</td><td></td></tr>
<tr><td>220kV or above class 3-phase shunt reactor of at least 20 MVAR capacity or at least three (3) nos. 1-phase Shunt Reactors each having capacity of at least 6.67 MVAR</td><td>applicable for supply of 220kV class Reactors</td></tr>
<tr><td>132kV or above class 3-phase shunt reactor of at least 15 MVAR capacity or at least three (3) nos. 1-phase Shunt Reactors each having capacity of at least 5 MVAR</td><td>applicable for supply of 132kV class Reactors</td></tr>
</table>
These Reactor(s) must have been in satisfactory operation# for atleast two (2) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) Such manufacturer has designed, manufactured based on technological support of collaborator, type tested (as per IEC/IS standard) and supplied 400kV class transformer or 220kV or above class shunt reactors (applicable for supply of 400kV class Reactors) / 220kV class transformer or 132kV or above class shunt reactors (applicable for supply of 220kV class Reactors)/ 132kV class transformer or 66kV or above class shunt reactors (applicable for supply of 132kV class Reactors) as on the date of NOA.

b) The collaborator meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply the Reactor in India, shall be submitted.

c) the collaborator shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor
</td></tr>
<tr><td>14.</td><td>Clause No 24.6</td><td>
Technical Requirement for 400 kV Grade XLPE Power Cables

(i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 400kV grade XLPE insulated cable which must be in operation for atleast 2 (two) years as on the date of NOA.

(ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

a) The manufacturer must have designed, manufactured, type tested and supplied 400kV grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA.

OR

b) The manufacturer must have designed, manufactured, type tested and completed Pre-qualification (PQ) tests as per IEC for 400kV grade XLPE insulated Cable as on the date of NOA.

Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of cable to supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor
</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
15.	**Clause No 24.7**	**Technical Requirement for 220KV,132kV,110kV Grade XLPE Power Cables** (i) The manufacturer(s) whose XLPE Power Cables are offered must have designed, manufactured, type tested and supplied in a single contract atleast 5 (five) km of single core, 220kV/132kV/110kV* or higher grade XLPE insulated cable which must be in operation for atleast 2 (two) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) The manufacturer must have designed, manufactured, type tested and supplied 220kV/132kV/110kV* or higher grade XLPE insulated cable and which must be in satisfactory operation# for atleast one (1) year as on the date of NOA. OR b) The manufacturer must have designed, manufactured, type tested and completed Pre-qualification (PQ) tests as per IEC for 220kV/132kV/110kV* or higher grade XLPE insulated Cable as on the date of NOA. Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of cable to supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor
16.	Clause No 24.15	**Technical Requirements for LT Transformer** (i) The manufacturer, whose LT transformer(s) are offered, must have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformer(s) of atleast 33kV class of 315kVA or higher. The transformer must have been in satisfactory operation# for atleast two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that At least 33kV class of 315kVA or higher rating LT transformer(s) must have been designed, manufactured in the above Indian works, type tested (as per IEC/IS standard) including short circuit test and supplied as on the date of NOA. Note In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of **10%** of the ex-works cost of the equipments(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor.
17.	Clause no 24.16	**Technical Requirements for Composite Long Rod Polymer Insulator (765kV & 400kV)** (i) The manufacturer whose Composite Long rod Insulator are offered, must have designed, manufactured, tested and supplied Composite Long rod Insulator of 120KN or higher electro-mechanical strength for 765kV/400kV* or higher voltage class and the same must have been in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) The manufacturer must have designed, manufactured, type tested and supplied Composite Long rod Insulator of 120KN or above electro-mechanical strength for 765kV/400kV* or higher voltage class and the same must have been in satisfactory operation# as on the date of NOA. b) Contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* and this performance guarantee shall be in addition to the contract performance guarantee to be submitted by the contractor.

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		Note: In case manufacturer meets the technical requirement through clause (ii) above, warranty obligations for additional warranty of two(2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 10% of the ex-works cost of the equipments(s)* for the additional warranty period in addition to the contract performance guarantee to be submitted by the contractor.
18.	Clause No. 24.20	**<u>Technical Requirement for 400kV GIS Equipment</u>** (i) The manufacturer whose 400kV GIS bays are offered must have designed, manufactured, type tested** (as per IEC or equivalent standard), supplied and supervised erection & commissioning of at least two (2) nos. Gas Insulated Switchgear (GIS) circuit breaker bays@ of 345kV or above voltage class in one (1) Substation or Switchyard during the last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) Atleast one no. 345kV or above voltage class GIS Circuit Breaker bay@ must have been manufactured in the above Indian works based on the technological support of the Collaborator(s) and either supplied or type tested the above CB bay (as per IEC or equivalent standard) as on the date of NOA. b) The collaborator(s) meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 400kV or above voltage level GIS equipment in India, shall be submitted. **c)** The Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder. Note :- (**) Type test reports of the collaborator/ parent company/ subsidiary company/ group company shall also be acceptable.
19.	New Clause Clause No. 24.21	**<u>Technical Requirement for 220/132/66 kV* level GIS/Hybrid GIS/MTS Equipment:</u>** (i) The manufacturer whose 220/132/66 kV* level GIS/Hybrid GIS/MTS bays are offered must have designed, manufactured, type tested** (as per IEC or equivalent standard), supplied and supervised erection & commissioning of at least two (2) nos. Gas Insulated Switchgear (GIS) circuit breaker bays@ of 220/110/66kV* or above voltage class in one (1) Substation or Switchyard during the last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the date of NOA. (ii) Alternatively, the manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that a) Atleast one no. 220/110/66kV* or above voltage level GIS Circuit Breaker bay@ must have been manufactured in the above Indian works based on the technological support of the Collaborator(s) and either supplied or type tested the above GIS bay (as per IEC or equivalent standard) as on the date of NOA. b) The collaborator(s) meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/license to design, manufacture, test and supply 220/110/66*kV or above voltage level GIS equipment in India shall be submitted. **c)** The Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder. **Note:**

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>
1. (*) voltage class of respective equipment as applicable

2. (@) For the purpose of technical requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs. GIS means SF6 Gas insulated Switchgear.

3. Experience with combination of GIS CB Bay/Hybrid GIS CB Bay/MTS CB Bay is also acceptable if supply of only Hybrid/MTS equipment is envisaged. Hybrid GIS means outdoor SF6 Gas insulated switchgear connected to outdoor Air insulated bus-bar System (AIS bus-bars System), MTS means outdoor SF6 Gas insulated Mixed Technology Switchgear connected to outdoor AIS bus bar system.

4. (**) Type test reports of the collaborator/ parent company/ subsidiary company/ group company shall also be acceptable
</td></tr>
<tr><td>20.</td><td>New Clause 27.0</td><td>
The technical parameters for 36kV & 12kV Horn gap fuse
1. 36kV Horn Gap Fuse
<table>
<tr><td>1.</td><td>Rated voltage</td><td>33 kV</td></tr>
<tr><td>2.</td><td>Maximum Continuous voltage</td><td>36 kV</td></tr>
<tr><td>3.</td><td>Rated current</td><td>50 Amps (min)</td></tr>
<tr><td>4.</td><td>Lighting Impulse voltage withstand</td><td>170 KV (Between Live and earth)
195 KV (Across open terminals)</td></tr>
<tr><td>5.</td><td>One minute Power frequency voltage withstand (Dry and Wet)</td><td>70 KV (Between Live and earth)
80 KV (Across open terminals)</td></tr>
<tr><td>6.</td><td>Creepage</td><td>900mm</td></tr>
</table>
2. 12kV Horn Gap Fuse
<table>
<tr><td>1.</td><td>Rated voltage</td><td>11 kV</td></tr>
<tr><td>2.</td><td>Maximum Continuous voltage</td><td>12 kV</td></tr>
<tr><td>3.</td><td>Rated current</td><td>50 Amps (min)</td></tr>
<tr><td>4.</td><td>Lighting Impulse voltage withstand</td><td>75 KV (Between Live and earth)
85 KV (Across open terminals)</td></tr>
<tr><td>5.</td><td>One minute Power frequency voltage withstand (Dry and Wet)</td><td>28 KV (Between Live and earth)
32 KV (Across open terminals)</td></tr>
</table>
Applicable standard: IS9385
</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>B.</td><td colspan="2">Section GIS Rev 5A</td></tr>
<tr><td>1.</td><td>New Para under Clause no.1</td><td>For GIS equipment of 52kV and above voltage class envisaged in one substation under a single package, can be supplied from more than one GIS manufacturers, however GIS for each voltage level shall be supplied from a single GIS manufacturer. Further a legally enforceable undertaking (jointly with the each GIS Manufacturer) as per enclosed format to be submitted along with the bidding documents.</td></tr>
<tr><td>2.</td><td>Clause no 5.12</td><td>“The maximum relative SF6 gas leakage rate shall not exceed 0.5% (half percent) per year for the whole equipment and for any individual gas compartment separately and the leakage rate shall be guaranteed for at least 10 years. In case the leakage under the specified conditions is found to be greater than 0.5% after commissioning during warranty period, the contractor shall rectify the defects to meet the leakage requirement and the manufacturer will have to supply free of cost, the total gas requirement for subsequent ten (10) years, based on actual leakage observed during the warranty period.
The maximum relative leakage rate for type tests shall be ≤ 0.1 % per year..”</td></tr>
<tr><td>3.</td><td>Clause no 5. 24</td><td>“The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions.”</td></tr>
<tr><td>4.</td><td>Clause no 5.27</td><td>Suitable portable scissor lift (as specified in BPS) for GIS shall be provided for access of distant portion of GIS installation.</td></tr>
<tr><td>5.</td><td>Clause no. 5.31</td><td>Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm and indication circuits.
Gas Insulating System:
i) Loss of Gas Density</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		Operating System: i) Low operating pressure ii)Loss of operating power iii)Loss of control supply iv) Pole Discordance.
6.	New Clause no. 5.39.8	Reference Guidelines for GIS Grounding shall be as per **Annexure-12 (Attached at Annexure-S10)**
7.	Clause no. 5.40	Adequate number of UHF sensors shall be provided in the offered GIS of voltage level 220kV and above for detection of Partial discharge (of 5pC and above) as per IEC 60270. The number and location of these sensors……..in close proximity to VT compartments. However, adequacy of number of sensors……. to complete the technical requirement. The calibration and frequency response…….couplers meeting this requirement.
8.	Clause no. 5.41	"*GIS manufacturer as per their design shall preferably use maximum **Fifteen** standard straight horizontal outdoor bus duct lengths for entire GIS installation to optimize the spare requirement."*
9.	New Clause no. 5.41(10)	The price of Bus-duct inside the GIS hall shall be integral part of the respective bay module and it will not be paid separately. However, the payment of bus-duct for outside the GIS hall along with support structure shall be paid as per running meters in line with provision of Bid Price schedule.
10.	New Para added under Clause no. 5.43.2	The gas density monitoring devices shall have IP rating of IP65 or better and Suitable canopy shall be provided to prevent ingress of rain water for outdoor application.
11.	Clause no. 6.8.2	The CSD shall be provided in following circuit breakers: a) 765kV • Main and Tie bay for Auto Transformer • Main and Tie bay of Bus Reactor • Switchable Line Reactor bay b) 400kV • Main and Tie bay for 765/400kV & 400/220kV Auto Transformer • Main and Tie bay of Bus Reactor • Switchable Line Reactor bay c) 220 & 132kV • Bay for operation of Shunt reactor The requirement of CSD shall be explicitly specified in price schedule.
12.	New Clause 6.8.3 (n)	For Circuit breaker with CSD controlling a Transformer following is applicable "The limit for inrush current for switching of Transformer by CSD shall be 1.0 p.u. of rated current of transformer after fine tuning of CSD settings during pre-commissioning checks. For site acceptance of CSD, during online CSD test after fine tuning inrush current should be less than 1.0 P.U. of rated current in five consecutive operations".
13.	New Clause no. 10.1.3(n)	For 400kV & above voltage class GIS bay module, CT cores shall be duly distributed on both side of circuit breaker. For 220 kV and below voltage level GIS bay module, CT on one side of the circuit breaker is also acceptable.
14.	New Clause no. 15.2.14	All 765kV & 400kV Circuit Breaker control schematics shall be finalized in such a way, that it may operate with or without CSD by using a suitable selector switch irrespective of whether circuit breakers to be supplied are envisaged along with CSD or not as per bid price schedules.
15.	Clause no. 17.1	*"For erection & maintenance of largest/heaviest GIS component/assembly, one number of EOT Crane of suitable capacity shall be provided for GIS Hall. The crane shall consist of all special requirements for erection & maintenance of GIS equipment."* *On completion of erection of the switchgear, the Contractor shall completely service the crane before the Taking Over Certificate is issued.*
16.	Clause no 17.2	Deleted
17.	Clause no 17.3	Deleted
18.	New Para added under	During detailed engineering, the type test reports of GIS equipment of the parent company/subsidiary company/group company shall also be acceptable provided that the design of offered GIS is same as that of type tested GIS equipment.

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td>Clause no. 20</td><td></td></tr>
<tr><td>19.</td><td>Clause no 20, Sl. no. 14 of Table</td><td>
<table>
<tr><td>14</td><td>Reactor current switching test for Inductive Current switching capability as per IEC 62271-110. Further, the manufacturer whose circuit breakers tested with smaller current w.r.t current limits specified for Reactor current switching test duty-2, 3 & 4 in IEC 62271-110 shall also be acceptable.</td></tr>
</table>
</td></tr>
<tr><td>20.</td><td>Clause no 24.12</td><td>Deleted</td></tr>
<tr><td>21.</td><td>Annexure-1
S.No. 20 (i)</td><td>
<table>
<tr><th>Parameter</th><th>765kV system</th><th>400kV system</th><th>220kV system</th><th>132 kV system</th></tr>
<tr><td>Pre-insertion resistor requirement</td><td>As per BPS</td><td>As per BPS</td><td>NA</td><td>NA</td></tr>
<tr><td>Rating (ohms)</td><td>Approx. 450 with tolerance as applicable</td><td>Approx. 400 with tolerance as applicable</td><td>NA</td><td>NA</td></tr>
</table>
</td></tr>
<tr><td>22.</td><td>Clause no 25 of Section GIS Rev 5A</td><td>25. ON SITE TESTING
After the GIS Switchgear has been fully installed at site and SF6 gas filled at rated filling density, the complete assembly shall be subjected to the site tests as per IEC-62271-203 and POWERGRID Asset Management Controlled Document No: D-3-01-09-01-02.
25.1 Deleted
25.2 Deleted.
25.3. In case of a disruptive discharge in the gas as outlined in clause no: C.6.2.2 Procedure b), Annexure-C of IEC 62271-203 during the AC voltage test and a repeat test is performed due to this failure, then the repeat test shall be carried out at Specified voltage.
25.4. Deleted.
25.5. Method statement/ procedure of ON SITE high voltage testing, PD measurement and test shall be submitted by contractor in advance</td></tr>
<tr><td>23.</td><td>New Para under Clause no 26.</td><td>Requirement for Mandatory spares for GIS
a. Any equipment which is not supplied as main equipment or part of main equipment, mandatory spare for that is not applicable.
b. It is recognized that the GIS manufacturer may have standardized the GIS design/equipment rating based on the manufacturer’s standard practice. Alternate proposals, offering higher rating equipment (without additional cost implication), will also be considered provided such equipment meets the specified minimum designs rating, standard and performance requirements.
c. In case contractor offers circuit breaker, dis-connector, current transformer, SF6/Air Bushing etc. under main equipment of higher rating than equipment rating specified in the specifications, the mandatory spare of same higher rating offered by contractor identical to main equipment offered in the package shall be required to be supplied against spares without any cost implication to POWERGRID.</td></tr>
<tr><td>24.</td><td>Annexure-10 Rev-1</td><td>Annexure-10 Rev-1 (Standard Mandatory Spares for Gas Insulated Switchgear) of stands deleted.</td></tr>
<tr><td>25.</td><td>New Annexure-13</td><td>Standard GIS Module Description (Attached at Annexure-S11)</td></tr>
<tr><td>C.</td><td colspan="2">Section Switchgear – CB Rev 11</td></tr>
<tr><td>1.</td><td>Clause no. 2.6 Para 2</td><td>The CSD shall be provided in following circuit breakers:
d) 765kV
• Main and Tie bay for Auto Transformer
• Main and Tie bay of Bus Reactor
• Switchable Line Reactor bay
e) 400kV
• Main and Tie bay for 765/400kV & 400/220kV Auto Transformer
• Main and Tie bay of Bus Reactor
• Switchable Line Reactor bay</td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>f) 220 & 132kV
• Bay for operation of Shunt reactor
The requirement of CSD shall be explicitly specified in price schedule.</td></tr>
<tr><td>2.</td><td>New Clause no. 2.6.1(n)</td><td>For Circuit breaker with CSD controlling a Transformer following is applicable

“The limit for inrush current for switching of Transformer by CSD shall be 1.0 p.u. of rated current of transformer after fine tuning of CSD settings during pre-commissioning checks. For site acceptance of CSD, during online CSD test after fine tuning inrush current should be less than 1.0 P.U. of rated current in five consecutive operations”.</td></tr>
<tr><td>3.</td><td>Clause No. 11.4</td><td>Separate cables shall be used for AC, DC-I, DC-II and selected DC. Each control cable shall include minimum 10% spare cores (subject to minimum 1 no. of spare core).</td></tr>
<tr><td>4.</td><td>Clause No. 11.5</td><td>Requirement of Plug-In type connector for Inter-pole cabling is deleted</td></tr>
<tr><td>5.</td><td>Clause No. 11.6</td><td>Vertical run of cables to the operating mechanism box shall be properly supported by providing the perforated closed type galvanized cable tray (Cable tray also to be supplied along with the Circuit Breaker) to be fixed as an integral part of the structures. The load of the cable shall not be transferred to the mechanism box/terminal arrangement in any circumstances. Hanging or loose run of cable is not permitted. The drawing of cable tray including fixing arrangement shall be incorporated in the GA drawing of CB also.</td></tr>
<tr><td>6.</td><td>Clause no 15.2 vii)</td><td>For Low & High temperature type test, Field performance report of CB’s as per IEC 62271-100 revision 2008 (covering amendment-2 in 2017) is also acceptable as valid Type test report.</td></tr>
<tr><td>7.</td><td>Clause No. 16.0 S.No. 20 (i)</td><td>
<table>
<tr><th>Parameter</th><th>765kV system</th><th>400kV system</th><th>220kV system</th><th>132 kV system</th><th>66kV System</th></tr>
<tr><td>Pre-insertion resistor requirement</td><td>As per BPS</td><td>As per BPS</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>Rating (ohms)</td><td>Approx. 450 with tolerance as applicable</td><td>Approx. 400 with tolerance as applicable</td><td>NA</td><td>NA</td><td>NA</td></tr>
</table>
</td></tr>
<tr><td>D.</td><td colspan="2">Section: Lighting System Rev 07</td></tr>
<tr><td>1.</td><td>New Para under Clause No. 2.1</td><td>Wherever, Indoor Illumination of building is specified as LS/Lot/SET item in BPS, illumination shall be provided using fixture types as specified in Annexure-I of Section: Lighting System. However, contractor shall submit lighting design calculation for deciding the number of fixtures in each building/room. Following Average lux (at working plane of height 1.2Mtrs from floor level) levels to be maintained for design of illumination system:
<table>
<tr><th>Sl.No.</th><th>Building/Room Type</th><th>Average Lux Level to be maintained</th></tr>
<tr><td>1</td><td>Control Room /Station-In charge Room /Administrative Room/Conference Room / Switchyard Panel Room/ GIS Relay Panel Room</td><td>300 Lux</td></tr>
<tr><td>2</td><td>Electronic Test Lab</td><td>250 Lux</td></tr>
<tr><td>3</td><td>GIS Hall/ Battery Room/ACDC & DCDB Room</td><td>200 Lux</td></tr>
<tr><td>4</td><td>AHU Room/GIS Store Room/ Pantry /Reception/ FFPH Building</td><td>150 Lux</td></tr>
<tr><td>5</td><td>Corridor/ Toilets</td><td>100 Lux</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>6</td><td>Periphery of the Building</td><td>50 Lux</td></tr>
<tr><td>7</td><td>Any other room/building</td><td>200 Lux</td></tr>
</table>
The minimum lux level to average lux level ratio should not be less than 0.6 (i.e Emin/Eav> 0.6).
The maintenance factor for indoor illumination design shall be considered as 0.8.
All required items /equipment /fixtures/ panels/ receptacles/ switches/ switchboards/ fans etc. for Illumination of Control Room Building, GIS Building, FFPH, SPR, Security Hut etc. (as applicable) are deemed to be included under corresponding LS/Lot/SET item of BPS.
</td></tr>
<tr><td>2.</td><td>Clause no 4.2</td><td>AC Emergency Lighting System
The lighting panels of this system will be connected to the 415 V
Emergency lighting distribution board (ELDB) which is fed from diesel
generator during the emergency. This system will be provided in Control Room building, GIS Building, Firefighting pump house, Switchyard Area including DG Set & LT Transformer Area. AC Emergency lighting load will be connected to this system which will be normally ‘ON’. Approximate 25 % of lighting fixtures (distributed over all above areas) shall be connected on AC emergency lighting system.</td></tr>
<tr><td>3.</td><td>New para under Clause no 5.1</td><td>EXTERNAL ELECTRIFICATION WORKS
Para-1
Para-2
Para-3
Townships DB’s shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.
Township DB shall be provided with a degree of protection of IP: 55.</td></tr>
<tr><td>4.</td><td>Clause no. 6.2.1(ii)</td><td>All Outdoor Lighting Panels shall be of Sheet steel atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.5 mm thick stainless steel of Grade 304 and shall be dust, weather and vermin proof. Panels shall be of smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary.</td></tr>
<tr><td>5.</td><td>Clause no. 6.6(i) (b)</td><td>The outdoor junction boxes shall be complete with conduit knockouts/ threaded nuts and provided with terminal strips. The junction boxes shall be suitable for termination of Cable glands of required size. The junction boxes shall be provided with 4-way knockouts suitable for street lighting/switchyard lighting terminals suitable for 2 numbers 4C x 16 Sq.mm Al. cable or as per requirement.
All Outdoor Junction boxes shall be of Sheet steel atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.5 mm thick stainless steel of Grade 304. Outdoor Junction Boxes shall be suitable for mounting on columns, structures etc for Outdoor Lighting. The outdoor Junction shall have IP 55 protection.”</td></tr>
<tr><td>6.</td><td>Cl. No. 6.7 (viii)</td><td>Earthing of the poles should be connected to the switchyard main
earth mat wherever it is available, else, the same should be earthed
through 3M long, 40 mm dia, earth electrode.</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>E.</td><td colspan="2">Section: LT Switchgear Rev 05</td></tr>
<tr><td>1.</td><td>Clause no. 1.21.2</td><td>Contractor shall submit type test reports for the Lighting transformers as per IS:2026 for which test conducted once are acceptable (i.e. The requirement of test conducted within last ten years shall not be applicable)</td></tr>
<tr><td>2.</td><td>Clause no. 1.6.1</td><td>MCCB shall in general conform to IS: 13947 Part-2. All MCCB offered shall have Ics = 100% Icu rating.</td></tr>
<tr><td>F.</td><td colspan="2">Section DG Set Rev 05</td></tr>
<tr><td>1.</td><td>New para added under Clause no. 7.1(a)</td><td>Alternatively, AMF Panel for DG Set may be installed outside the acoustic enclosure near the DG Set. In such cases, AMF panel with or without additional enclosure shall meet IP-55 degree of protection.</td></tr>
<tr><td>G.</td><td colspan="2">Section Fire Protection Rev 06</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
1.	New para added at Clause no.2.03.00	Fire detection and alarm system shall also be provided in the GIS Hall using beam type smoke detectors to be installed at suitable mounting height, and in the Relay Panel room with ionization/optical type smoke detectors to be installed on the ceiling.
2.	New Clause no.2.01.02	Hydrant posts and Fire extinguishers (CO2 and DCP type) shall also be provided for GIS Building also.
3.	Clause No. 2.04.02 & 10.00.00	Mechanical foam type fire extinguishers wherever specified as 50 litre capacity, conforming to IS:13386, shall be read as 60 litre capacity conforming to IS 16018 Further in case of non-availability of any type of fire extinguisher (i.e. water, CO2, DPC, foam type) of a particular size as specified in BPS or technical specification, next available higher size conforming to IS shall be supplied.
4.	New Clause No. 2.06.05	For new substation, Fire Fighting LT Boards (AC & DC) and Annunciation panels (for FFPH & Control Room Building), shall have number of feeders, annunciation windows, zone-alarm modules (as applicable) required for entire present & specified future scope of the substation.
5.	Clause No.9.01.00 (c) & Appendix-V	Deleted
6.	Appendix-I	Appendix-I (Rev 4) **s**tand replaced by following **Appendix-I (Rev 5)**
7.	Appendix-IV	Revised Appendix-IV Page1 of 13 is replaced by **Annexure-IV rev 01 Page1 of 13.**
H	**Section: Power & Control Cable Rev 06**	
1.	Clause no 1.1.4	Refer **Annexure-S1** for METHODOLOGY FOR SIZING OF CABLES
2.	Clause no 1.2.2	1.2.2. XLPE Power Cables 1.2.2.1. The XLPE (90°C) insulated cables shall be of FRLSH type, C2 category conforming to IS: 7098 (Part-I) and its amendments read alongwith this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS:5831. All cables shall be of armoured type. For single core cables, the armouring shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables
3.	Clause no 1.2.3	1.2.3. PVC Power Cables 1.2.3.1. The PVC (70°C) insulated power cables shall be of FRLSH type, C2 category, conforming to IS: 1554 (Part-I) and its amendments read alongwith this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath shall be provided in all multicore cables. All cables shall be of armoured type. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.
4.	Clause no 1.2.4	1.2.4. PVC Control Cables 1.2.4.1. The PVC (70°C) insulated control cables shall be of FRLSH type C2 category conforming to IS: 1554 (Part-1) and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables. All cables shall be of armoured type. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.
5.	Clause No. 4.2	Standard lengths for each size of power and control cables shall be 500/1000 meters. However, to avoid cable wastage and cable jointing at site, non-standard lengths of each size of Power & Control cable may also be acceptable subject to maximum length of 1000meters (+ 5% tolerance)
6.	Clause No. 5	5 TYPE TESTS 5.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS. 5.2 XLPE INSULATED POWER CABLES (For working voltages up to and including 1100V):-

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		5.2.1 Following type tests (on one size in a contract) as per IS: 7098 (Part 1) – 1988 including its amendments shall be carried out as a part of acceptance tests on XLPE insulated power cables for working voltages up to and including 1100 V: a) Physical tests for insulation i) Hot set test ii) Shrinkage test b) Physical tests for outer sheath i) Shrinkage test ii) Hot deformation iii) Heat shock test iv) Thermal stability c) Test for Smoke density (as per relevant IS/IEC standard) d) Test for halogen acid gas evolution. e) Flame Retardant on Single cable. f) Flame Retardant on bunched cable. 5.2.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following tests a) Water absorption (gravimetric) test. b) Ageing in air oven c) Loss of mass in air oven d) Short time current test on power cables of sizes 240 sqmm and above on i) Conductors. ii) Armours. e) Test for armouring wires/strips. f) Oxygen and Temperature Index test. g) Flammability test. h) Smoke density test (on sheathing material) (as per relevant IS/IEC standard)
7.		5.3 PVC INSULATED POWER & CONTROL CABLES (For working voltages up to and including 1100V)- 5.3.1 Following type tests (on one size in a contract) as per IS: 1554 (Part 1) -1988 including its amendments shall be carried out as a part of acceptance tests on PVC insulated power & control cables for working voltages up to and including 1100 V: a) Physical tests for insulation and outer sheath i) Shrinkage test ii) Hot deformation iii) Heat shock test iv) Thermal stability b) High voltage test (water immersion test only a.c. test as per clause no. 16.3.1). c) Test for Smoke density (as per relevant IS/IEC standard) d) Test for halogen acid gas evolution. e) Flame Retardant on Single cable 5.3.2 Contractor shall submit type test reports as per clause no. 9.2 of Technical Specification, Section: GTR for the following a) High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1) - 1988). b) Ageing in air oven. c) Loss of mass in air oven. d) Short time current test on power cables of sizes 240 sqmm and above on i) Conductors. ii) Armours. e) Test for armouring wires/strips. f) Oxygen and Temperature Index test. g) Flammability test h) Flame Retardant on bunched cable

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td>8.</td><td></td><td>Note:- In technical data sheet for 1.1kV XLPE/PVC Power cable & PVC control cable, wherever Type & Category of Cable is written FR & C1 shall be read as FR-LSH & C2, other details kept the same.</td></tr>
<tr><td>I.</td><td colspan="2">Section-Air Conditioning Rev-04</td></tr>
<tr><td>1.</td><td>Clause No. 2.3.2.3</td><td>Cooling capacity of 3TR AC units shall not be less than 36000btu/hr. and shall have minimum energy efficiency rating of 4 star as on the date of NOA.</td></tr>
<tr><td>2.</td><td>Clause No. 2.3.3.4</td><td>Cooling capacity of 2TR AC units shall not be less than 22000btu/hr. and shall have minimum energy efficiency rating of 4 star as on the date of NOA.</td></tr>
<tr><td>3.</td><td>Clause no. 2.4</td><td>Clause no. 2.4 of Section-Air Conditioning Rev-04 of Technical Specification Void</td></tr>
<tr><td>4.</td><td>New Annexure-S2</td><td><u>Annexure S2</u> – Air Conditioning & Ventilation System for GIS Building</td></tr>
<tr><td>J.</td><td colspan="2">Section Switchyard Erection Rev 10</td></tr>
<tr><td>1.</td><td>New Clause No. 2.5</td><td>Transmission line side insulator string along with hardware for line termination shall be in the scope of substation contractor. The erection of same shall be done by associated TL contactor.</td></tr>
<tr><td>2.</td><td>Clause No. 9.4(j) & (k)</td><td>
<table>
<tr><th>S.No</th><th>Item</th><th>Size</th><th>Material</th></tr>
<tr><td>j)</td><td>Isolator MOM Box</td><td>50X6 mm GS flat & Flexible copper braid</td><td>Galvanised steel and copper braid</td></tr>
<tr><td>k)</td><td>Insulator Guy Arrangement</td><td>75x12mm G.S. flat</td><td>Galvanised Steel</td></tr>
</table>
</td></tr>
<tr><td>3.</td><td>New Clause No. 9.5.8</td><td>For estimation of riser of new substation/switchyard, maximum spacing of Main Earthmat shall be considered as 30 M x 30 M, 24 M x 24 M, 16 M x 16 M & 12 M x 12 M for 765kV, 400kV, 220kV & 132kV switchyard respectively.

For 765/400/220/132kV Substation, maximum spacing of higher voltage level shall be considered for calculating the riser quantiites.

Actual spacing for main earthmat shall be finalized during detailed engineering based on soil resistivity data and payment shall be made as per actual executed quantity at site. However, no cost compensation shall be considered in case of actual spacing of main earthmat finalized during detailed engineering is less than that mentioned above.

For switchyard extensions, main earthmat spacing shall be considered same as that in the existing switchyard.</td></tr>
<tr><td>4.</td><td>Clause no 9.10.3</td><td>Auxiliary earthing mat comprising of minimum 32mm dia M.S. rods closely spaced (300 mm x 300 mm) conductors shall be provided at depth of 300mm from ground level below the operating handles of the M.O.M. Box of the isolators. M.O.M. boxes shall be directly connected to the auxiliary earthing mat. Flexible copper braid connection to be provided between MOM box and GI flat to take care of soil sagging. The size of auxiliary earthing mat shall be of 1500mmx1500mm size for 220kV and above voltage class isolators and 900mmx900mm size for 132kV and below voltage class isolators. Factory welded auxiliary earthmat is preferable.</td></tr>
<tr><td>5.</td><td>New Clause No. 10.2</td><td>Following type of conductor for Flexible or Rigid Bus bars/Switchyard Equipment Jumpers/Interconnections shall be provided subject to suitability of conductor as per specified/applicable current ratings:

<table>
<tr><th>Voltage Level</th><th>Conductor / Al .Tube Type</th></tr>
<tr><td>Voltage Level: 765kV</td><td>AAC Bull / 4.5’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 400kV</td><td>ACSR Bersimis / 4.5’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 220kV</td><td>ACSR Moose / 4.0’’ IPS Al. Tube</td></tr>
<tr><td>Voltage Level: 132kV</td><td>ACSR Moose / 3.0’’ IPS Al. Tube</td></tr>
</table>

For substation extension works, suitable clamps & connectors for interconnection with existing buses as per drawings shall be provided by the contractor under present scope.

Conductor type with higher current rating than that specified above shall also be acceptable without any additional price implication.</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		Note: For existing substation, existing conductor configuration may preferably be adopted in extn. S/s package.
6.	New Clause no. 20.1	**Neutral formation for Transformer(s), DELTA formation and making connection arrangement to connect spare unit in place of any unit of the bank without physical shifting and Earthing Arrangement :** For Spare Unit connection to form 3-ph bank of 765kV Class Transformers with isolator based switching arrangement without physical shifting of spare unit along with necessary Neutral Formation, Earthing Arrangement & Tertiary (DELTA) formation for 3-ph bank formation with 1-ph units shall be under present scope as per the details mentioned below: **i. Neutral Formation including Neutral auxiliary bus and Earthing Arrangement** The contractor shall connect the neutrals of three (3) 1-phase transformers by overhead connection using 3" IPS Al tube. The neutral formation shall be such that neutral winding of single-phase spare transformer can be disconnected or connected to the three phase banks. The connection from the neutral bushing to neutral bus shall be through 3" IPS Al tube and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminium tube, conductor, clamps & connectors, earthing materials, support structure, **foundation bolts,** hardware etc. required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. **ii. Tertiary Delta Formation including Tertiary auxiliary bus(Insulation level 52 kV) .** The contractor shall connect 33kV tertiary of single-phase auto-transformers in DELTA configuration by overhead connection to operate in 3-Ph Bank. The Delta shall be formed by 3" IPS Al tube, which shall be insulated with heat shrinkage insulating sleeve of at least 52kV class and shall be supported by structure mounted bus post insulators at suitable intervals. Jumpers (twin conductors) wherever provided shall also be insulated using suitable insulation tape or sleeve at least 52kV class at site. The minimum phase to phase horizontal spacing for delta formation shall be 1.5meter. All associated materials like bus post insulators, Aluminium tube, conductor, clamps & connectors, support structures, **foundation bolts,** hardware, earthing materials etc. required for tertiary delta formation shall be provided by the contractor. **iii. HV & IV Auxiliary Buses (Applicable for AIS Substation)** Formation of HV & IV auxiliary buses for connection of transformer 3-Phase bank with 1-Phase Spare transformer unit is under the present scope of the bidder. All associated materials like Bus post insulators, Aluminium tube, conductors, clamps & connectors, insulator strings, hardware, earthing materials, support structures, **foundation bolts,** required for the above-mentioned arrangement shall be provided by the contractor.
7.	New Clause no. 20.2	**Neutral formation for Reactor banks, connection to neutral grounding reactor through 132kV Surge arrester, connection to ground through neutral CTs and connection arrangement to connect spare reactor unit in place of any other units of the bank without physical shifting and Earthing Arrangement :** For Spare Unit connection to 3-ph bank of 765kV Class Reactors with isolator based switching arrangement without physical shifting of spare unit along with necessary Neutral Formation, Earthing Arrangement for 3-ph bank formation with 1-ph units shall be under present scope as per the details mentioned below: **i. Neutral Formation including Neutral auxiliary bus and Earthing Arrangement** The contractor shall connect the neutrals of three (3) 1-phase reactors by overhead connection using 3" IPS Al tube. The neutral formation shall be such that neutral winding of single-phase spare reactor can be disconnected or connected to the three phase banks. Neutral Connections of spare unit shall be extended upto the other unit(s) by forming Neutral auxiliary bus. The connection from the neutral bushing to neutral bus shall be through 3" IPS Al tube and wherever flexible jumper needs to be provided, same shall be through twin conductor. All material like Bus post insulator, Aluminum tube, conductor, clamps & connectors, earthing materials, support structure, **foundation bolts,** hardware etc. required for neutral formation and connection with neutral CT and earthing of neutral shall be provided by contractor. Required Insulation level is 145 kV from individual reactor neutral to point of neutral formation. However after neutral formation, the insulation level is 36kV.

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		Connection of each Line reactor bank formed under present scope to Neutral grounding reactor through 132kV Surge Arrester including NGR by passing arrangement is also under present scope. **ii. HV Auxiliary Bus (Applicable for AIS Substation)** Formation of HV auxiliary bus for connection of reactor 3-Phase bank with 1-Phase Spare reactor unit is under the present scope of the bidder. All associated materials like Bus post insulators, Aluminium tube, conductors, clamps & connectors, insulator strings, hardware, earthing materials, support structures, **foundation bolts,** required for the above-mentioned arrangement shall be provided by the contractor.
8.	New Clause no. 20.3	Supply & Laying of Power, Control Cables & Special Cables (if any) (including all cabling works for spare unit of transformer/reactor) along with accessories for power supply, alarm, trip, control & indication, status and monitoring signals & contacts made available at MB/CMB of Transformers/Reactors upto Control & Relay Panels and BCUs located in the Switchyard Panel Room/Control Room and successful integration of same with Station Control, Protection & SAS System is in the scope of the contractor.
9.	New Clause no. 20.4	3½Cx300 Sq. mm XLPE power cable for oil filtration units of reactors & transformers shall be provided. The cable shall be terminated at 250A receptacle near Reactor & Transformer in the switchyard. XLPE Power cables shall be looped in & out for 250A Power receptacles.
10.	New Clause no. 20.5	Neutral of spare transformer/reactor is to be connected to station grounding system through a jumper/copper flat. This shall be applicable for single phase transformer/reactor wherever spare unit have been provided.
11.	New Clause no. 20.6	Tertiary connections made for tertiary loading of LT Transformer shall be insulated using suitable insulation tape or sleeve of at least 52kV class at site
12.	New Clause no. 20.7	The earthing risers from terminal of Neutral Current Transformer (NCT) of bank of 1-Phase Transformer/Reactor (as applicable) shall be brought down for connection with pipe electrodes by providing suitable insulators mounted on NCT support structure (minimum 2 nos. per support). Necessary provisions on NCT support structure for mounting of insulator shall be provided. These insulators shall deemed to be included in corresponding Erection Hardware item for Transformer/Reactor bay (as applicable) of BPS
13.	New Clause No. 21	Connection arrangement of 765kV equipment's shall be done as per the conceptual drawing (Drawing No. C/ENGG/SS/CONCEPTUAL 765KV BAY CONNECTIONS, Rev-01) enclosed as **Annexure-S3** of this Section.
14.	New Clause No. 22	For connection to HV bushing of LT Transformer, insulated copper rod/strip of at least 75 sq.mm cross sectional area shall be used.
15.	New annexure	Refer **Annexure-S4** for SHORT CIRCUIT FORCES & SPACER SPAN FOR 765kV & 400kV GANTRY STRUCTURE
K.	**Section CRP Rev 09**	
1.	New Para added under Clause No.5.1	Requirement of Shrouding shall not be applicable to TB's where live parts are concealed.
2.	New para added under Clause no.18.8	Line Differential relays used as both Main –I & Main-II protection of a line, shall be of either different make & model or shall be on different hardware platform.
3.	New para added under	Directional Earth Fault Relay/Function provided shall have Carrier Aided scheme feature which shall be suitable for single phase auto re-closure schemes

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td>Clause no.18.9(s)</td><td></td></tr>
<tr><td>4.</td><td>Clause no. 19.1. (a), (b) and (d)</td><td>a) have single phase & 3 phase reclosing facilities.
b) have a continuously variable dead time range of 0.1-2 seconds.
(d) Auto reclose scheme shall have provision of selection of the following modes:-
i. Single phase.
ii. Three Phase.
iii. Single & three phase.
iv. Non-Auto
The necessary provision in the scheme shall be provided to select the A/R mode from both local and remote</td></tr>
<tr><td>5.</td><td>New Para added under Clause No. 20.4</td><td>Wherever, scope for NGR by passing is envisaged, necessary equipment, wiring etc. required for control & monitoring of 145kV Circuit Breaker for NGR by-passing arrangement shall be under contractor’s scope of work. The same may be located in respective line/reactor protection panel.</td></tr>
<tr><td>6.</td><td>Clause No. 21.1 (e)</td><td>be suitable for individual input from associated CTs with rated CT secondary current of 1 Amp.</td></tr>
<tr><td>7.</td><td>New Clause No. 21.8</td><td>Back-up Impedance protection function shall be provided for 765kV & 400kV sides of 765/400/33kV ICT and for 400kV side of 400kV class ICT. This protection function can be clubbed with any other protection IED’s except of Differential Protection IDC.</td></tr>
<tr><td>8.</td><td>Clause No. 32.9</td><td>The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following :
• Potential free contact (Minimum pulse duration of 50 milli seconds.)
• IRIG-B
• RS232C
• SNTP Port (at least 4 ports)
• IEEE 1588 PTP (Applicable only for Process bus automation station)</td></tr>
<tr><td>9.</td><td>New clause 24.3 q)</td><td>In case of extension substation with distributed bus bar protection, if Bay unit is envisaged under scope of the contract, it shall be compatible with the existing central unit. In such case type test for the bay unit once conducted shall hold good. The requirement of type test conducted within last seven years, shall not be applicable for the bay unit.</td></tr>
<tr><td>10.</td><td>Clause no 37. IV Breaker Relay Panel</td><td>BREAKER RELAY PANEL: The breaker relay panel shall consist of the following:
<table>
<tr><th>Sl. No.</th><th>Description</th><th>Qty</th></tr>
<tr><td>1.</td><td>Breaker failure Protection Scheme*</td><td>1no.</td></tr>
<tr><td>2.</td><td>DC supply Supervision relay</td><td>2nos.</td></tr>
<tr><td>3.</td><td>Trip Circuit supervision relays#</td><td>6nos.</td></tr>
<tr><td>4.</td><td>Auto-reclose scheme (##)</td><td>1No.</td></tr>
<tr><td>5.</td><td>Flag relays, aux relays, timers, trip relays as per scheme requirements</td><td>As required</td></tr>
<tr><td>Note-1)</td><td colspan="2"># Trip supervision relays shall be 2 or 6 numbers as per no. of trip coils for each 132KV Circuit breaker</td></tr>
<tr><td>Note- 2)</td><td colspan="2">Equipment/relays to be provided under CB Relay Panel may be accommodated in the Protection Panels to be provided for Transmission Line/Transformer/Reactor as applicable</td></tr>
<tr><td>Note- 3)</td><td colspan="2">* In case of bay extension in existing half diameter, breaker failure relay for main CB / Tie CB shall be supplied only if BFR built-in Bus Bar protection bay unit is not available or Tie CB standalone BFR relay is not available in the existing protection scheme.</td></tr>
<tr><td>Note-3)</td><td colspan="2">## Auto reclose scheme shall also be acceptable as a part of BCU. All Circuit Breaker Relay Panel shall be provided with Auto-reclose function. However, during execution stage Auto-reclose function shall be enabled/ disabled based on requirement</td></tr>
</table></td></tr>
<tr><td>11.</td><td>Clause no 41 (b)</td><td>POWERGRID has standardized binary input/output details, indication details, DR signals & texts, etc. of protection IEDs, SAS HMI Signal List, Protection Panels CT/VT circuit termination detail, Trip Logic etc. and the same shall be used by contractor during detail engineering for preparation of schematics. Standardized documents are attached as Folder APPENDIX-C. Panel nomenclature, terminal blocks identification, as applicable, shall be according to typical detail given at APPENDIX-B (Additional part of TS)</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
L.	**Section SAS Rev 04**	
1.	Typical Architectural Drawing of SAS (Without Process Bus)	TYPICAL ARCHITECTURAL DRAWING OF SUBSTATION AUTOMATION SYSTEM (Without Process Bus) stands replaced by **Annexure-S5**
2.	Clause no 1.6	The Sub-station Automation system being offered shall generally conform to provisions of IEC 62351, IEEE1686 and NERC CIP (applicable parts such as CIP 003, CIP-005, and CIP-007) for cyber security. Detailed Cyber Security Requirements, FAT Checklist & SAT Checklist of Control and Protection IEDs & other components are attached as **Annexure-S12 (Annexure-II)-**CyberSecurity_ Requirements_ R0, **Annexure-S13 (Annexure-III)--**FAT_Checklist_R0 & **Annexure-S14 (Annexure-IV)--**SAT_Checklist_R0 respectively
3.	Para 2 under Clause No. 3.3.1	The Substation Automation System shall have communication ports on each gateway (two gateways per station) as follows: (a) Three ports for Remote Control Centres on Secure IEC60870-5-104 protocol. **(b) Two port on IEC 60870-5-104 for Regional System Coordination Centre (RSCC)**
4.	New Para Added Under Clause No.4.1	Redundant Station HMI, Remote HMI (Remote HMI only if mentioned in section project) and Disturbance Recorder Work station: Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement **Technical Specification for Industrial Grade Computers** The minimum hardware configuration of workstation console shall be: • Intel Core i7 processor (8 cores) or better (3Ghz or above) • Minimum 32 GB RAM (DDR4 or better) • Minimum 1 TB SSD • DVD-RW drive • Dual Gigabit Ethernet ports (RJ-45) o Additional Gigabit Ethernet ports shall be provided depending upon the functional requirements. • Input/Output Ports: 2 output ports for Dual Monitor display capability (VGA/HDMI/DVI output ports), 6 USB (minimum 2 USB 3.0 ports), Standard Audio ports (Line in/out & Mic), 2 serial ports, and 1 parallel port. • USB Keyboard and USB Mouse • Speakers for audible alarms (for HMI computers only) • 27 inches LED color monitor (Qty. as per requirement) o Diagonal Viewable size: 27 inches o Resolution: minimum 1920 x 1080 o Color support: 16 million o Input video signal: VGA, DVI, HDMI o 4 way adjustable (tilt, swivel, pivot, height) o On Screen Controls o Anti-glare, anti-reflection and anti-static o Sufficiently wide horizontal & vertical viewing angles **The minimum Software requirement of the workstation console shall be:** • Preinstalled OEM Licensed Microsoft Windows 10/11 Pro 64-bit or latest with media DVD (or) Recovery DVD**.**

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
5.	New Para Added Under Clause No.4.1.5	The bidder shall also provide 2 Nos. managed Ethernet switches with at least 16 copper RJ45 ports on each switch to form managed "Redundant System LAN" for connecting different NTAMC sub-systems devices (SCADA Gateways, VMS, VOIP etc.) as per revised system architecture **(attached as Annexure S5)**. The specification of the switches is enclosed at **Annexure-S6.**
6.	Para 2 Under Clause No.4.1.6	Contractor shall provide 2 nos. Next Generation Firewalls (NGFW); one No. Main & one No. Standby having electrical ethernet interfaces/ports and placed between FOTE & SAS gateways, NTAMC switch etc. at the substation. All ethernet based applications (e.g. PMU, AMR, VOIP, SAS/SCADA etc.) shall be terminated in the firewall ports directly. Each port of firewall shall work as a separate zone. Firewall shall be hardware based with functionality of Block/Allow/drop and IPSec VPN (network encryption). Minimum 16 Nos. of ports/interfaces shall be provided in each firewall (i.e. Main & Standby) Contractor can use either single firewall or multiple firewalls to meet this interfaces requirement, each for main as well as standby firewall. Minimum throughput of firewall shall be 300 Mbps. The Firewall shall be managed/ configured as standalone at present and shall also have compatibility to manage/configure through Centralized Management Console (CMC) remotely in future. OEM Support on 24x7 basis for 7 years shall be provided for all the functions & features of the Firewall. Firewall shall be tested and certified for ISO15408 Common Criteria for least EAL4+. Further, the OEM must certify that it conforms to Secure Product Development Life Cycle requirements as per IEC62443-4-1. The firewall shall generate reports for NERC-CIP Compliance. The specifications for the firewalls are attached at **Annexure-S7.**
7.	Para 3 Under Clause No.4.1.6	The substation routers shall have the following features: - Routing protocols such as OSPF and support for IPv4 and IPv6 **- 8 Ethernet interfaces of 10/100 Mbps** - 2 E1 interfaces - Hot standby operation with a similar router - Support IEEE 802.3u, 802.1p, 802.1Q, 802.1d, 802.1w, - Traffic prioritization for routed IP flows/ports
8.	Bullet no.4 under Clause No. 4.2.1	Each BCU shall be equipped with Local HMI (display) facilities, enabling control of each particular bay from BCU whenever required. The Local HMI facilities shall be accomplished by means of Graphical LCD display embedded into the front panel of the BCU. Display will show the SLD (with device identification number) showing status of bay switching equipment (such as circuit breaker, isolators, earth switches) and enabling issuance of switching controls. Other display type will be multiple displays of analog values readings / reports, displays for controls other than switching, Alarm panel displays, Diagnostic/ online configuration displays etc. **Bay control unit shall have inbuilt metering CVT supervision function. It shall have feature to give alarm in case of CVT/PT metering core fuse fail.**
9.	Clause 4.2.2 New bullet	Bay Control Units for Main System and Auxiliary system at a station shall be classified as below based on it's application and Contractor shall supply following types of BCU applicable under the subject package: Bay control Unit (IED) of Main System (a). Main Bay BCU (b). Tie Bay BCU (c). Switchable Line Reactor Bay BCU Bay control Unit (IED) of Auxiliary System (a) Auxiliary BCU
10.	Clause no. 8.2	*The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system including Control Relay Protection (CRP) for approval based on the standard SAS/CRP FAT procedure of POWERGRID.* ***The Standard SAS FAT format & procedure is provided at Appendix-II (revised)& the Standard CRP FAT format & procedure is provided at Appendix-III (Additional part of TS) for reference guideline.*** *For the individual bay level IED's applicable type test certificates shall be submitted*
11.	New Clause 15.4	Mandatory spares: a. Mandatory Spares for Substation Automation shall be supplied as per BPS. b. The offered "Bay control Unit (IED) of Main System" as spare, shall be sufficient to replace all types of Bay control Units supplied under Main system without addition of any hardware/module etc.

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>Further any additional I/O module and/or hardware supplied under Main system to meet the functional requirement of Bay control Unit in any bay, shall be considered part of Bay control Unit (IED) of Main System.
The offered “Bay control Unit (IED) of Auxiliary System” as spare, shall be sufficient to replace all types of Auxiliary BCU supplied under Auxiliary system without addition of any hardware/module etc.

Further any additional I/O module and/or hardware supplied under Auxiliary system to meet the functional requirement of Bay control Unit shall be considered part of Bay control Unit (IED) of Auxiliary System</td></tr>
<tr><td>12.</td><td>Clause No. 16.0 (v)</td><td><u>LIST OF EQUIPMENTS</u>

v) Two nos. Disturbance Recorder/Engineering Workstation where at least one workstation shall have Linux based operating system.</td></tr>
<tr><td>M.</td><td colspan="2">Section PLCC Rev 05</td></tr>
<tr><td>1.</td><td>New Clause No. 6.12.4</td><td>For 765 kV Wave Trap, cantilever strength of BPIs used for Wave Trap shall be 10 kN.</td></tr>
<tr><td>2.</td><td>New Clause no. 10.4.13</td><td>All protection couplers (Analog protection coupler, digital protection coupler) shall be equipped with direct reading type counter facility for all the codes (Tx & Rx).</td></tr>
<tr><td>3.</td><td>New Clause no.10.5</td><td>Digital protection coupler (DPC) shall be used as one of the two tele-protection channel on the lines between the stations having Optical Fiber link alongwith SDH Equipment. Specification of digital protection coupler is enclosed as <u>Annexure-S8.</u> The DPC can be housed either in offered Control & Protection Panel / PLCC Panel or in separate panel. Generally SDH Equipment are placed in communication room of Control room where as DPC is placed in panel room. The connection between SDH equipment and each DPC shall be through Optical fiber. Necessary cables, converter(s) for converting E1 signal to optical fiber at both ends (at Panel Room as well as at Control room) along with FODP shall be in the scope of the contractor. Further sharing of additional spare ports of converter for DPC placed in other Panel Room or in same Panel Room is also permitted. Necessary optical fiber for interconnection of DPC is to be provided by the contractor. Further any copper wiring for ensuring the protection signaling/data/speech shall be in the scope of the contractor.</td></tr>
<tr><td>N.</td><td colspan="2">VISUAL MONITORING SYSTEM (if specified in BPS)</td></tr>
<tr><td>1.</td><td></td><td>Technical Specification for Visual Monitoring System for watch and ward of substation premises is attached at <u>Annexure-S9</u></td></tr>
<tr><td>O.</td><td colspan="2">Section –400KV Transformer Rev 13</td></tr>
<tr><td>1.</td><td>Clause no 4</td><td>The following shall constitute as Measurable Defects for the purpose of Defect Liabilities as per relevant clauses of GCC / SCC of the bidding document:

a) Repair, inside the Transformer and OLTC (including oil migration) either at site or at factory is carried out after commissioning
b) The concentration of any fault gas is more than respective values as per Table-2 of IEEEC57.104-2019, which are as detailed below

<table>
<tr><th>Fault GAS</th><th>O2/N2 Ratio <u>≤</u>0.2</th><th>O2/N2 Ratio >0.2</th></tr>
<tr><td>Hydrogen (H2)</td><td>200</td><td>90</td></tr>
<tr><td>Methane (CH4)</td><td>150</td><td>50</td></tr>
<tr><td>Ethene (C2H6)</td><td>175</td><td>40</td></tr>
<tr><td>Ethylene (C2H4)</td><td>100</td><td>100</td></tr>
<tr><td>Acetylene (C2H2)</td><td>02</td><td>07</td></tr>
<tr><td>Carbon Monoxide (CO)</td><td>1100</td><td>600</td></tr>
<tr><td>Carbon dioxide (CO2)</td><td>12500</td><td>7000</td></tr>
</table>
If fault gases except CO and CO2 are well below the limit as specified above during warrantee period, furan test may be carried out to ascertain the degree of degradation of the transformer paper insulation. Based on measured furan values CO & CO2 levels may be re-evaluated
c) The winding tan delta goes beyond 0.005 or increase more than 0.001 within a year w.r.t. pre-commissioning values. No temperature correction factor shall be applicable for tan delta.
d) The moisture content goes above 12 ppm at any temperature during operation including full load.</td></tr>
<tr><td>2.</td><td>Clause no 6.2.6</td><td>The transformer shall be provided with a suitable diameter pipe flange, gate valve, bolted blanking plate and gasket shall be fitted at the highest point of the transformer for maintaining vacuum in the tank.</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
3.	New Clause no 6.6.6	Buchholz Relay Pipe support (if required) shall be provided from ground to avoid transfer of undue vibration to Buchholz Relay from pump or fans connected with transformer, resulting in maloperation
4.	Clause No. 6.5.1	Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture. Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service. Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay. **Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.**
5.	Clause no 8.2.6	Transportation of Oil The insulating oil for the Transformer shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in bulk storage, pilferage and fire hazard. In case this oil is not filled in Transformer due to delay in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits. Insulating oil shall be delivered to the site in returnable flexi bag / stainless steel tanker. The flexi bag / tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case, before contract closing. However, the spare oil shall be delivered in non-returnable drums.
6.	Clause no 9.1	**Particles in the oil** The particle analysis shall be carried out in an oil sample taken before carrying out FAT at manufacturer's works and after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17- "Effect of particles on transformer dielectric strength". Particle limit as shown below shall be ensured by manufacturer, implying low contamination, as per CIGRE Brochure 157, Table 8. Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5 μm; 130 particle/100 ml with size ≥ 15 μm.
7.	Clause no 10.5	**Deleted**
8.	Clause no 11	**Neutral Formation and Earthing Arrangement** (if specified in BPS)
9.	New Clause no 12.6.1.5	Fire protection operated signal shall be included in the control circuit of Auxiliary power supply distribution scheme to disconnect the power supply to IMB/CCC and associated instrument/devices of CMB to restrict further exaggeration of fire.
10.	New Clause no 12.6.2.4	Fire protection operated signal shall be included in the control circuit of Auxiliary power supply distribution scheme to disconnect the power supply to associated instrument/devices to restrict further exaggeration of fire.
11.	Clause no 13.1	Buchholz Relay, Magnetic Oil Level Gauge, Pressure Relief Device & Sudden pressure relay to be wired through unarmoured cable of 1.5 sq.mm (minimum), inside covered cable tray or GI conduit, with no part exposed. Cable shall be protected by flexible stainless steel pipe, at both ends as per requirement. Proper sealing arrangement to be provided at both ends to avoid ingress of water. The cross section of "control cable" shall be 1.5 sq.mm (minimum) except for CT circuits which should be 2.5 sq.mm (minimum). All other cables shall be armoured type and shall be routed through covered cable tray or GI conduit and shall be properly dressed.
12.	Clause no 17.1	Current transformers shall comply with IS 2705/ IS 16227 (Part 1 & 2)/IEC 61869 (part 1 & 2).
13.	Annexure-H	**ANNEXURE - H** **1.1 KV GRADE POWER & CONTROL CABLES** **…** **…** **STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)** **STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES)**

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)</td></tr>
<tr><td>14.</td><td>New para added under Annexure-E</td><td>Painting Procedure

For coastal area reactor (external surface) painting shall be of C5 type as per ISO 12944-5 with total DFT 320 µm (minimum).</td></tr>
<tr><td>P.</td><td colspan="2">Section 400kV Shunt Reactor Rev. 11</td></tr>
<tr><td>1.</td><td>Clause no. 5</td><td>The following shall constitute as Measurable Defects for the purpose of Defect Liabilities as per relevant clauses of GCC / SCC of the bidding document:
a) Repair, inside the Transformer and OLTC (including oil migration) either at site or at factory is carried out after commissioning
b) The concentration of any fault gas is more than respective values as per Table-2 of IEEEC57.104-2019, which are as detailed below
<table><tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr><tr><td>Hydrogen (H2)</td><td>200</td><td>90</td></tr><tr><td>Methane (CH4)</td><td>150</td><td>50</td></tr><tr><td>Ethene (C2H6)</td><td>175</td><td>40</td></tr><tr><td>Ethylene (C2H4)</td><td>100</td><td>100</td></tr><tr><td>Acetylene (C2H2)</td><td>02</td><td>07</td></tr><tr><td>Carbon Monoxide (CO)</td><td>1100</td><td>600</td></tr><tr><td>Carbon dioxide (CO2)</td><td>12500</td><td>7000</td></tr></table>If fault gases except CO and CO2 are well below the limit as specified above during warrantee period, furan test may be carried out to ascertain the degree of degradation of the transformer paper insulation. Based on measured furan values CO & CO2 levels may be re-evaluated.
c) The winding tan delta goes beyond 0.005 or increase more than 0.001 within a year w.r.t. pre-commissioning values. No temperature correction factor shall be applicable for tan delta.
The moisture content goes above 12 ppm at any temperature during operation including full load</td></tr>
<tr><td>2.</td><td>Clause No. 7.2.7</td><td>The Reactor shall be provided with a 100 mm nominal diameter Gate valve and bolted blanking plate, gasket and shall be fitted at the highest point of the Reactor for maintaining vacuum in the tank</td></tr>
<tr><td>3.</td><td>Clause No. 7.5.1</td><td>Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture.
Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.

Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay.

Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.</td></tr>
<tr><td>4.</td><td>Clause No. 7.6.6</td><td>Buchholz Relay Pipe support (if required) shall be provided from ground to avoid transfer of undue vibration to Buchholz Relay from pump or fans connected with reactor, resulting in maloperation</td></tr>
<tr><td>5.</td><td>Clause no 7.14.4</td><td>Each Reactor unit should have provision for earthing and connected to grounding mat when not in service. For this purpose, line Terminals shall also be earthed through neutral by flexible copper connection. Contractor shall provide suitable arrangement for the above. 1.1kV Grade PVC FRLSH type cable of 16 sq.mm (minimum) shall be used for above connection. Neutral shall have provision for connection to ground by a brass/tinned copper grounding bar supported from the tank by using porcelain insulator. The end of the tinned/brass copper bar shall be brought to the bottom of the tank at a convenient point for making bolted connection to 75 X 12 mm GS flat connected to station grounding mat. The other end of the tinned/brass copper bar shall be connected to the neutral bushing through flexible conductor/jumper.</td></tr>
<tr><td>6.</td><td>Clause no 9.2.6</td><td>Transportation of Oil The insulating oil for the Reactor shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in balk storage, pilferage and fire hazard. In case this oil is not filled in reactor due to delay</td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits.

Insulating oil shall be delivered to the site in returnable flexi bag / stainless steel tanker. The flexi bag / tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case before contract closing. However, the spare oil shall be delivered in non-returnable drums.</td></tr>
<tr><td>7.</td><td>Clause no 11.14</td><td>Tan delta at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP,RIP & RIS) at reactor manufacturing works / bushing manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.</td></tr>
<tr><td>8.</td><td>Clause no 15.1</td><td>Buchholz Relay, Magnetic Oil Level Gauge, Pressure Relief Device & Sudden pressure relay to be wired through unarmoured cable of 1.5 sq.mm (minimum), inside covered cable tray or GI conduit, with no part exposed. Cable shall be protected by flexible stainless steel pipe, at both ends as per requirement. Proper sealing arrangement to be provided at both ends to avoid ingress of water.

The cross section of “control cable” shall be 1.5 sq.mm (minimum) except for CT circuits which should be 2.5 sq.mm (minimum).</td></tr>
<tr><td>9.</td><td>Clause no 16.17</td><td>Fire protection operated signal shall be included in the control circuit of Auxiliary power supply distribution scheme to disconnect the power supply to IMB/CCC and associated instrument/devices of CMB to restrict further exaggeration of fire.</td></tr>
<tr><td>10.</td><td>Clause no 18.1</td><td>Current transformers shall comply with IS 2705/ IS 16227 (Part 1 & 2)/IEC 61869 (part 1 & 2).</td></tr>
<tr><td>11.</td><td>Clause no 22.1 xxxii)</td><td>All Cables (Power, control and shielded / twisted pair for 4-20mA cable from Reactor MB, other control cubicle, etc. (as applicable) to CMB (if applicable) shall be under the present scope. Any special cable if required to be included upto employer‟s C&R panel.</td></tr>
<tr><td>12.</td><td>Annexure-A</td><td>Technical Particulars / Parameters of 245kV Shunt Reactor

2.17 b) Chopped Wave Lightning Impulse Withstand Voltage
HV: 1045 kVp</td></tr>
<tr><td>13.</td><td>Annexure-A</td><td>Technical Particulars / Parameters of Neutral Grounding Reactor (NGR)

4.12 Max. temperature rise over ambient temperature of 50øC at rated voltage.

of top oil measured by thermometer: 45

of winding measured by resistance: 50</td></tr>
<tr><td>14.</td><td>Annexure-B</td><td>Test Plan
Test on NGR

<table>
<tr><th colspan="2">Test on NGR</th></tr>
<tr><td>Item</td><td>Test</td></tr>
<tr><td>Measurement of winding resistance</td><td>Routine</td></tr>
<tr><td>Measurement of Impedance by V/I</td><td>Routine</td></tr>
<tr><td>Measurement of insulation resistance</td><td>Routine</td></tr>
<tr><td>Measurement of Capacitance & Tan delta of winding insulation to earth and bushing</td><td>Routine</td></tr>
<tr><td>Lightning impulse test</td><td>Routine</td></tr>
<tr><td>Separate source voltage withstand test</td><td>Routine</td></tr>
<tr><td>Isolation Test</td><td>Routine</td></tr>
<tr><td>Oil leakage test</td><td>Routine</td></tr>
<tr><td>Appearance, construction and dimension check</td><td>Routine</td></tr>
<tr><td>High voltage with stand test on auxiliary equipment and wiring after assembly</td><td>Routine</td></tr>
<tr><td>Tank Vacuum test</td><td>Routine</td></tr>
<tr><td>Tank Pressure test</td><td>Routine</td></tr>
<tr><td>Measurement of vibration at rated continuous current</td><td>Routine</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Measurement of loss</td><td>Routine</td></tr>
<tr><td>Short time current test and measurement of impedance at short time current</td><td>Type</td></tr>
<tr><td>Measurement of acoustic sound / noise level</td><td>Type</td></tr>
<tr><td>Temperature rise test</td><td>Type</td></tr>
</table>
</td></tr>
<tr><td>15.</td><td>Annexure-D</td><td>Sl. nos. (i) and (iv) of Reference Drawings mentioned at Annexure-D stands deleted.</td></tr>
<tr><td>16.</td><td>Annexure-E</td><td>Painting Procedure

For coastal area reactor (external surface) painting shall be of C5 type as per ISO 12944-5 with total DFT 320 µm (minimum).</td></tr>
<tr><td>17.</td><td>Annexure-H</td><td>Technical Parameters of Current Transformers - 420 kV Shunt Reactor On each phase connection & Neutral Grounding Reactor (NGR)
b) Minimum knee point voltage or burden and accuracy class (Neutral side CT)
Core-1 : 200V, PX / PS Class</td></tr>
<tr><td>18.</td><td>Annexure-I</td><td>ANNEXURE - I
1.1 KV GRADE POWER & CONTROL CABLES
…
…
STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)</td></tr>
<tr><td>19.</td><td>Clause no 9.1</td><td>Particles in the oil
The particle analysis shall be carried out in an oil sample taken before carrying out FAT at manufacturer’s works and after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17- “Effect of particles on transformer dielectric strength”. Particle limit as shown below shall be ensured by manufacturer, implying low contamination, as per CIGRE Brochure 157, Table 8.
Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5µm; 130 particle/100 ml with size ≥ 15µm.</td></tr>
<tr><td>Q.</td><td colspan="2">Section- 765kV Auto-transformer Rev 08</td></tr>
<tr><td>1.</td><td>clause no 4</td><td>The following shall constitute as Measurable Defects for the purpose of Defect Liabilities as per relevant clauses of GCC / SCC of the bidding document:

a) Repair, inside the Transformer and OLTC (including oil migration) either at site or at factory is carried out after commissioning
b) The concentration of any fault gas is more than respective values as per Table-2 of IEEEC57.104-2019, which are as detailed below

<table>
<tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr>
<tr><td>Hydrogen (H2)</td><td>200</td><td>90</td></tr>
<tr><td>Methane (CH4)</td><td>150</td><td>50</td></tr>
<tr><td>Ethene (C2H6)</td><td>175</td><td>40</td></tr>
<tr><td>Ethylene (C2H4)</td><td>100</td><td>100</td></tr>
<tr><td>Acetylene (C2H2)</td><td>02</td><td>07</td></tr>
<tr><td>Carbon Monoxide (CO)</td><td>1100</td><td>600</td></tr>
<tr><td>Carbon dioxide (CO2)</td><td>12500</td><td>7000</td></tr>
</table>
If fault gases except CO and CO2 are well below the limit as specified above during warrantee period, furan test may be carried out to ascertain the degree of degradation of the transformer paper insulation. Based on measured furan values CO & CO2 levels may be re-evaluated</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		c) The winding tan delta goes beyond 0.005 or increase more than 0.001 within a year w.r.t. pre-commissioning values. No temperature correction factor shall be applicable for tan delta **d)** The moisture content goes above 12 ppm at any temperature during operation including full load
2.	Clause 6.5.1	Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture. Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service. Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay. **Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and socket with cable at site is not acceptable.**
3.	New Clause 6.6.7	Buchholz Relay Pipe support (if required) shall be provided from ground to avoid transfer of undue vibration to Buchholz Relay from pump or fans connected with transformer, resulting in maloperation
4.	Clause no 6.14.4	Each transformer unit should have provision for earthing and connected to grounding mat when not in service. For this purpose, all line Terminals shall also be earthed through neutral by flexible copper connection. Contractor shall provide suitable arrangement for the above. 1.1kV Grade PVC FRLSH type cable of 16 sq.mm (minimum) shall be used for above connection. Neutral shall have provision for connection to ground by a brass/tinned copper grounding bar supported from the tank by using porcelain insulator. The end of the tinned/brass copper bar shall be brought to the bottom of the tank at a convenient point for making bolted connection to 75 X 12 mm GS flat connected to station grounding mat. The other end of the tinned/brass copper bar shall be connected to the neutral bushing through flexible conductor/jumper.
5.	Clause no 8.1	**Particles in the oil** The particle analysis shall be carried out in an oil sample taken before carrying out FAT at manufacturer's works and after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17- "Effect of particles on transformer dielectric strength". Particle limit as shown below shall be ensured by manufacturer, implying low contamination, as per CIGRE Brochure 157, Table 8. Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5µm; 130 particle/100 ml with size ≥ 15µm.
6.	Clause no 8.2.6	**Transportation of Oil** The insulating oil for the Transformer shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in balk storage, pilferage and fire hazard. In case this oil is not filled in Transformer due to delay in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits. Insulating oil shall be delivered to the site in returnable flexi bag / tanker. The flexi bag / Stainless steel tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case, before contract closing. However, the spare oil shall be delivered in non-returnable drums.
7.	Clause no 10.15	Tan delta at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP,RIP & RIS) at transformer manufacturing works / bushing manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.
8.	New Clause no 13.4.5	Fire protection operated signal shall be included in the control circuit of Auxiliary power supply distribution scheme to disconnect the power supply to IMB/CCC and associated instrument/devices of CMB to restrict further exaggeration of fire.
9.	Clause no 14.1	Buchholz Relay, Magnetic Oil Level Gauge, Pressure Relief Device & Sudden pressure relay to be wired through unarmoured cable of 1.5 sq.mm (minimum), inside covered cable tray or GI conduit, with no part exposed. Cable shall be protected by flexible stainless steel pipe, at both ends as per requirement. Proper sealing arrangement to be provided at both ends to avoid ingress of water. The cross section of "control cable" shall be 1.5 sq.mm (minimum) except for CT circuits which should be 2.5 sq.mm (minimum). All other cables shall be armoured type and shall be routed through covered cable tray or GI conduit and shall be properly dressed.

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td>10.</td><td>Clause no 19.1</td><td>Current transformers shall comply with IS 2705/ IS 16227 (Part 1 & 2)/IEC 61869 (part 1 & 2).</td></tr>
<tr><td>11.</td><td>New para added under Annexure-E</td><td>Painting Procedure

For coastal area application, transformer (external surface) and outdoor cubicle painting (Except Stainless Steel material) shall be of C5 type as per ISO 12944-5 with total DFT 320 μm (minimum).</td></tr>
<tr><td>12.</td><td>Annexure-H</td><td>ANNEXURE - H
1.1 KV GRADE POWER & CONTROL CABLES
…
…
STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES) – VOID (Parameters of Standard Technical Data Sheet shall not be referred to)</td></tr>
<tr><td>R.</td><td colspan="2">Section-765kV Shunt Reactor, Rev. 08</td></tr>
<tr><td>1.</td><td>Clause no. 5</td><td>The following shall constitute as Measurable Defects for the purpose of Defect Liabilities as per relevant clauses of GCC / SCC of the bidding document:
a) Repair, inside the Transformer and OLTC (including oil migration) either at site or at factory is carried out after commissioning
b) The concentration of any fault gas is more than respective values as per Table-2 of IEEEC57.104-2019, which are as detailed below
<table>
<tr><th>Fault GAS</th><th>O2/N2 Ratio ≤0.2</th><th>O2/N2 Ratio >0.2</th></tr>
<tr><td>Hydrogen (H2)</td><td>200</td><td>90</td></tr>
<tr><td>Methane (CH4)</td><td>150</td><td>50</td></tr>
<tr><td>Ethene (C2H6)</td><td>175</td><td>40</td></tr>
<tr><td>Ethylene (C2H4)</td><td>100</td><td>100</td></tr>
<tr><td>Acetylene (C2H2)</td><td>02</td><td>07</td></tr>
<tr><td>Carbon Monoxide (CO)</td><td>1100</td><td>600</td></tr>
<tr><td>Carbon dioxide (CO2)</td><td>12500</td><td>7000</td></tr>
</table>
If fault gases except CO and CO2 are well below the limit as specified above during warrantee period, furan test may be carried out to ascertain the degree of degradation of the transformer paper insulation. Based on measured furan values CO & CO2 levels may be re-evaluated
c) The winding tan delta goes beyond 0.005 or increase more than 0.001 within a year w.r.t. pre-commissioning values. No temperature correction factor shall be applicable for tan delta.
d) The moisture content goes above 12 ppm at any temperature during operation including full load</td></tr>
<tr><td>2.</td><td>Clause no 7.1.11(b)</td><td>Specific area shall not be provided for jacking pad in the foundation as jacking shall be done by laying metal plates size 400 mm x 400 mm x 32 mm (min) thick. One set of metal plates for jacking of Reactor shall be provided by manufacturer.</td></tr>
<tr><td>3.</td><td>Clause no 7.2.7</td><td>The Reactor shall be provided with a 150 mm nominal diameter Gate valve and bolted blanking plate, gasket and shall be fitted at the highest point of the Reactor for maintaining vacuum in the tank</td></tr>
<tr><td>4.</td><td>Clause No. 7.5.1</td><td>Conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture.
Conservator Protection Relay (CPR)/Air cell puncture detection relay shall be installed to give alarm in the event of lowering of oil in the conservator due to puncture of air cell in service.

Conservator shall be fitted with magnetic oil level gauge (Plug & socket type arrangement) with potential free high and low oil level alarm contacts and prismatic oil level gauge and Conservator Protection Relay.
Plug & socket type arrangement with factory fitted cable of adequate length shall be supplied by OEM. Connection of plug and</td></tr>
</table>

S.No.	Clause No.	Amended As (As per Specific Requirement Rev 10)
		socket with cable at site is not acceptable.
5.	New Clause no 7.6.6	Buchholz Relay Pipe support (if required) shall be provided from ground to avoid transfer of undue vibration to Buchholz Relay from pump or fans connected with reactor, resulting in maloperation
6.	Clause no 7.14.4	Each Reactor unit should have provision for earthing and connected to grounding mat when not in service. For this purpose, line Terminal shall also be earthed through neutral by flexible copper connection. Contractor shall provide suitable arrangement for the above. 1.1kV Grade PVC FRLSH type cable of 16 sq.mm (minimum) shall be used for above connection. Neutral shall have provision for connection to ground by a brass/tinned copper grounding bar supported from the tank by using porcelain insulator. The end of the tinned/brass copper bar shall be brought to the bottom of the tank at a convenient point for making bolted connection to 75 X 12 mm GS flat connected to station grounding mat. The other end of the tinned/brass copper bar shall be connected to the neutral bushing through flexible conductor/jumper.
7.	Clause no 8.1	**Particles in the oil** The particle analysis shall be carried out in an oil sample taken before carrying out FAT at manufacturer's works and after completion of the oil filtration at site. The procedure and interpretation shall be in accordance with the recommendation of CIGRE report WG-12.17- "Effect of particles on transformer dielectric strength". Particle limit as shown below shall be ensured by manufacturer, implying low contamination, as per CIGRE Brochure 157, Table 8. Limiting value for the particle count are 1000 particle/100 ml with size ≥ 5 μm; 130 particle/100 ml with size ≥ 15 μm.
8.	Clause no 9.2.6	Transportation of Oil The insulating oil for the Reactor shall be delivered at site generally not before 90 days from the date of commissioning, with prior information to the Employer, in view of risk involved in balk storage, pilferage and fire hazard. In case this oil is not filled in reactor due to delay in commissioning, same oil shall be used only after testing and ensuring that oil parameters are well within the specified limits. Insulating oil shall be delivered to the site in returnable flexi bag / tanker. The flexi bag / Stainless steel tanker shall be taken back without any extra cost to Employer within generally 45 days after utilisation of oil but in any case before contract closing. However, the spare oil shall be delivered in non-returnable drums
9.	Clause no 11.16	Tan delta at variable frequency (in the range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing (OIP,RIP & RIS) at reactor manufacturing works / bushing manufacturing works as routine test before despatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing.
10.	Clause no 15.1	Buchholz Relay, Magnetic Oil Level Gauge, Pressure Relief Device & Sudden pressure relay to be wired through unarmoured cable of 1.5 sq.mm (minimum), inside covered cable tray or GI conduit, with no part exposed. Cable shall be protected by flexible stainless steel pipe, at both ends as per requirement. Proper sealing arrangement to be provided at both ends to avoid ingress of water. The cross section of "control cable" shall be 1.5 sq.mm (minimum) except for CT circuits which should be 2.5 sq.mm (minimum). All other cables shall be armoured type and shall be routed through covered cable tray or GI conduit and shall be properly dressed.
11.	Clause no 16.18	Fire protection operated signal shall be included in the control circuit of Auxiliary power supply distribution scheme to disconnect the power supply to IMB/CCC and associated instrument/devices of CMB to restrict further exaggeration of fire.
12.	Clause no 17.1.1	All required power & control cables including optical cable, patch chord (if any) upto MB (for 3-Ph unit) or Common MB (for 1-Ph unit) shall be in the scope of contractor. Further, any special cable between MB (for 3-Ph unit) or Common MB (for 1-Ph unit) to switchyard panel room/control room shall be under the present scope.
13.	Clause no 17.1.2	Fiber optic cable, power cable, control cables, as applicable, between MB (for 3-Ph unit) or Common MB (for 1-Ph unit) to switchyard panel room/control room and power supply (AC & DC) to MB and integration of above said IEC-61850 compliant equipment with Substation Automation System shall be under the scope of EPC contractor.
14.	Clause no 18.1	Current transformers shall comply with IS 2705/ IS 16227 (Part 1 & 2)/IEC 61869 (part 1 & 2).

<table>
<tr><th>S.No.</th><th>Clause No.</th><th>Amended As (As per Specific Requirement Rev 10)</th></tr>
<tr><td>15.</td><td>Clause no 22.xxix)</td><td>All Cables (Power, control and shielded / twisted pair for 4-20mA cable from Reactor MB, other control cubicle, etc. (as applicable) to CMB (if applicable) shall be under the present scope. Any special cable if required to be included upto employer’s C&R panel.</td></tr>
<tr><td>16.</td><td>New para added under Annexure-E</td><td>Painting Procedure

For coastal area reactor (external surface) painting shall be of C5 type as per ISO 12944-5 with total DFT 320 µm (minimum).</td></tr>
<tr><td>17.</td><td>Annexure-I</td><td>ANNEXURE - I
1.1 KV GRADE POWER & CONTROL CABLES
…
…
STANDARD TECHNICAL DATA SHEET (1.1kV GRADE XLPE POWER CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC POWER CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)

STANDARD TECHNICAL DATA SHEET (1.1kV GRADE PVC CONTROL CABLES)
– VOID (Parameters of Standard Technical Data Sheet shall not be referred to)</td></tr>
<tr><td>18.</td><td>Annexure-C</td><td>Sl. nos. (i) and (iii) of Reference Drawings mentioned at Annexure-C stands deleted.</td></tr>
<tr><td>S.</td><td></td><td>BATTEY AND BATTEY CHARGER</td></tr>
<tr><td>1.</td><td><u>Clause no 1.2.14.2.</u></td><td><u>List of Factory & Site Tests for Battery</u>

<table>
<tr><th>Sl. No.</th><th>Test</th><th>Factory Tests</th><th>Site Tests</th></tr>
<tr><td>1.</td><td>Physical Verification</td><td></td><td>✓</td></tr>
<tr><td>2.</td><td>C/10 Capacity test on the cell</td><td>✓</td><td>✓</td></tr>
<tr><td>3</td><td>8 Hrs. Charge and 15 minutes discharge test at full rated load</td><td></td><td>✓</td></tr>
</table>
</td></tr>
<tr><td>T.</td><td></td><td>FREQUENTLY ASKED QUESTIONS</td></tr>
<tr><td>1.</td><td></td><td>Frequently Asked Questions attached at Annexure-S15</td></tr>
</table>

Sl. No.	Power System Equipment	Minimum Local Content (%)
1	Power Transformers (up to 765 kV, including Generator Transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (Up to 400kV)	60
6	Resin Insulated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765kV AC-Alternating Current)	60
8	Disconnectors, Isolators (up to 765kV AC)	60
9	Wave Trap (up to 765kV AC)	60
10	Oil Filled Distribution Transformers up to & including 33kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry type Distribution Transformers up to & including 33kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional conductor	60
13	Accessories for conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and accessories	60
15	Optical ground wire (OPGW)- all designs	60
16	Fiber Optic Terminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33kV	60
20	Control cables including accessories	60
21	XLPE cables up to 220kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Long Rod Insulators with Room temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) system (up to 800kV)	60
33	Gas Insulated Switchgear (up to 400kV AC)	60
34	Gas Insulated Switchgear (above 400kV AC)	50
35	Surge/Lightning Arrester (up to 765kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6kV to 33kV)	60
38	Ring Main Unit (RMU) (up to 33kV)	60

39	Medium Voltage (MV) GIS panels (up to 33kV)	60
40	Automation and Control system/Supervisory Control and Data Acquisition (SCADA) system in Power system	50
41	Control and Relay panel (including Digital/Numerical relays)	50
42	Electrical motors 0.37kW to 1MW	60
43	Energy meters excluding smart meters	50
44	Control and Power cables and accessories (up to 1.1kV)	60
45	Diesel Generating (DG) set	60
46	DC system (DC Battery & Battery Charger)	60
47	AC and DC Distribution board	60
48	Indoor Air Insulated Switchgear (AIS) up to 33kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxiliary Relays	50
55	Load Break Switch	50
56	Cranes, EOT cranes, gantry crane & chain pulley blocks, etc	60
57	Elevator	60
Fire Protection and Detection system		
58	Motor driven fire water pumps	60
59	Diesel engine driven fire water pumps	60
60	Hydrant system	60
61	High velocity water spray system	60
62	Medium velocity water spray system	60
63	Foam Protection system	60
64	Inert gas flooding system	60
65	Fire tenders	60
66	Portable fire-extinguishers	60

Assessment report from Contractor for proposed sub-vendor along with following enclosures (to the extent available):

1. Proof of MSME certificate (Udhyam registration), if applicable
2. Registration / License of the works
3. Organization chart with name and qualification of key persons
4. List of Plant and Machinery.
5. List of testing equipment with their calibration status.
6. List of Raw material, bought out items with sourcing details
7. List of out-sourced services with sourcing details.
8. List of supply in last three years.
9. Third party approval, if any (viz. ISO, BIS),
10. Pollution clearance wherever applicable
11. Energy Conservation & Efficiency report
    (Applicable to industries having contract load more than 100 KVA)
12. Formats for RM, in process and acceptance testing
13. Type test approvals conducted in last 5 years, if applicable
14. Performance Certificates from customers
15. Photographs of factory, plant and machinery & testing facilities
16. Audit report of the proposer, in case of request for approval of new vendor is submitted by Contractor/Sub-vendor

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Annexure-G Rev 01

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
A.01	LT Transformer /Power Transformer/ Reactor/ Converter Transformer/ Filter Reactor	MQP/ITP	IV
A.02	Bushing	MQP	IV
A.03	Insulating Oil	POWERGRID TS	III
A.04	Oil storage tank for transformers	MQP	III
A.05	Nitrogen injection-based explosion prevention system	FAT/ITP	III
A.06	Online oil drying system for transformers	POWERGRID TS	II**
A.07	Online DGA and moisture monitoring system	POWERGRID TS	II**
A.08	Flow sensitive conservator isolation valve	POWERGRID TS	II**
A.09	Oil Filtration Machine	MQP	III
B.01	Circuit Breakers	MQP	IV
B.02	Current Transformers	MQP/ITP	IV
B.03	CVT/PT/IVT	MQP	IV
B.04	Isolators	MQP/ITP	IV
B.05	Surge Arrestors	MQP/ITP	III
B.06	Line Trap & Air Core Reactor	MQP/ITP	III
B.07	Point On switching device (CSD) for Circuit Breaker (wherever required)	FAT/ITP	I
C.01	STATCOM including Valve, valve base electronics, DC capacitor, series reactor and all accessories	ITP	IV
C.02	Mechanically switched Reactor bank (3-ph) including all accessories (MSR Branches)	ITP	IV
C.03	Mechanically switched Capacitor bank (3-ph) including all accessories (MSC Branches)	ITP	IV
C.04	Harmonic Pass filters	ITP	IV
C.05	HT Capacitor	MQP	IV
D.01	Thyristor Valve	FAT/ITP	III
D.02	PLC Capacitors for HVDC	FAT/ITP	III
D.03	Valve Cooling system for HVDC	FAT/ITP	III
D.04	AC/DC Filter Resistors	ITP	III
D.05	DC Current and Voltage measuring device for HVDC	FAT/ITP	III
D.06	Maintenance platform for valve hall	POWERGRID TS	II
D.07	Optical signal column for FSC	FAT/ITP	II
E.01	GIS including spares	MQP/ITP	IV
E.02	Dew Point Meter for GIS	POWERGRID TS	I*
E.03	Portable Partial Discharge monitoring system for GIS	POWERGRID TS	I*

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Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
E.04	Partial Discharge Monitoring System (Online) for GIS	ITP	III
E.05	PEB Structure and Puf Panels	MQP	III
F.01	Substation Automation system	FAT/MQP	III
F.02	Event Logger	POWERGRID TS	III
F.03	PLCC equipment Viz PLCC Terminal, Carrier equipment, Protection Coupler , Coupling Device but excluding EPABX / HF Cable	MQP	III
F.04	Control & Relay Panels	MQP	III
G.01	EHV Cables	MQP/ITP	III
G.02	Power Cables & Control Cables	MQP	III
G.03	Cable Joints (11 kV and above)	POWERGRID TS	II
G.04	Cable Lugs & Glands / Clamps/Terminations	POWERGRID TS	I
G.05	Distributed Temperature Sensing Instrument (DTS)	POWERGRID TS	II
H.01	LT Switchgear & ACDB/DCDB/MLDB/ELDB	MQP	III
H.02	Battery	POWERGRID TS	II
H.03	Battery Charger	MQP	III
H.04	UPS & Voltage Stabilizer	MQP/FAT	III
H.05	D. G. Set	FAT/ITP	III
H.06	Lighting Panel	POWERGRID TS	II
H.07	Lighting Poles	POWERGRID TS	II
H.08	Lighting Earthwire, Switches / sockets, Conduits, Lamps & fans including exhaust fans	POWERGRID TS	I
H.09	MS/GI /PVC Pipes for cable trenches and lighting	POWERGRID TS	I
H.10	Outdoor Receptacle	POWERGRID TS	I
H.11	Split A.C/window A.C./ precision AC/ Kiosk AC/ Cascade AC/ Tower AC	POWERGRID TS	I
H.12	Occupancy sensors for control of lighting	POWERGRID TS	I
H.13	Solar based street lighting pole including Solar Panel, Inverter, Controller, etc.	POWERGRID TS	III
H.14	Junction Box / Lighting Switch Boards / Bay MB / Portable Flood Light Panel	POWERGRID TS	II
H.15	Lighting transformer	POWERGRID TS	II
H.16	LED Lighting Fixtures	POWERGRID TS/FAT	III
I.01	SF6 gas processing unit, SF6 gas Leakage detector, SF6 gas Analyzer	POWERGRID TS	I*
I.02	SF6 Gas	POWERGRID TS	I
I.03	Spark Gap	FAT/ITP	III
I.04	Time synchronizing Equipment (GPS Clock)	POWERGRID TS	I
I.05	Galvanized Cable trays	POWERGRID TS	II
I.06	Video Monitoring System	FAT/ITP	I
I.07	Public Address System (All Components)	POWERGRID TS	I

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
I.08	Building Management System (All components)	POWERGRID TS	I
I.09	Access Control System (All Components)	POWERGRID TS	I
I.10	Video Display system/ Video Projection system	POWERGRID TS	I
I.11	VESDA (smoke detector)	POWERGRID TS	I
I.12	High Mast Pole	MQP	III
J.01	Aluminium ladder	POWERGRID TS	I
J.02	Hume Pipes	POWERGRID TS	I
J.03	Castle Key	POWERGRID TS	I
J.04	Water Treatment plant (All components).	POWERGRID TS	I
J.05	Furniture	POWERGRID TS	I
J.06	DOL Starter	POWERGRID TS	I
J.07	Oil Sample Bottles and Syringe	POWERGRID TS	I
J.08	Test & Measuring Equipment, T&P	POWERGRID TS	I*
K.01	EOT Crane	POWERGRID TS	II
K.02	Boom Crane/Golf Cart/Platform Truck/Man Lift/ Forklift/ Lifts	POWERGRID TS	II
L.00	Fire Protection System		
L.001	Panels, Hydro pneumatic tank for fire protection system.	POWERGRID TS	III
L.002	Deluge valve, Strainers, MS/GI pipes, Pumps, motors, air compressor, Solenoid and other valves, Diesel Engines	POWERGRID TS	II
L.003	Others	POWERGRID TS	I
M.00	HVAC SYSTEM		
M.001	Air Cooled Chiller	POWERGRID TS	III
M.002	Pump	POWERGRID TS	II
M.003	Air Handling Unit	POWERGRID TS	II
M.004	Fan Filter Unit With Centrifugal Blower	POWERGRID TS	II
M.005	Axial Flow Fan	POWERGRID TS	II
M.006	Main Climate Control Unit (Dehumidifier)	POWERGRID TS	I
M.007	Dampers	POWERGRID TS	II
M.008	Fire Dampers	POWERGRID TS	II
M.009	Pressure Gauge, Thermometers, Other Instruments / Sensors	POWERGRID TS	I
M.010	Grill, Diffuser, Jet Nozzle, Louvers etc	POWERGRID TS	I
M.011	Ducting	POWERGRID TS	III
M.012	M S Pipe	POWERGRID TS	II
M.013	Pipe Insulation Material	POWERGRID TS	I
M.014	Duct Insulation Material	POWERGRID TS	I
M.015	Underdeck Insulation Material	POWERGRID TS	I
M.016	Gate Valve & Non-Return valve	POWERGRID TS	I
M.017	Y Strainer	POWERGRID TS	II
M.018	Ball Valve/ Motorized Butterfly Valve/ Balancing Valve	POWERGRID TS	I

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
M.019	Closed Expansion Tank	POWERGRID TS	II
M.020	Air Separator	POWERGRID TS	I
M.021	MCC /PLC /Electrical Panels	POWERGRID TS	III
M.022	Propeller Fan/ Conduit	POWERGRID TS	II
M.023	Air Filter/ Mixing Valve with Thermostat	POWERGRID TS	I
N.01	SDH Equipment	FAT/ITP	IV
N.02	Termination Equipment Primary/ DI Multiplexer	FAT/ITP	IV
N.03	DACS	FAT/ITP	IV
N.04	Optical Amplifier	FAT/ITP	IV
N.05	FODP including pigtail, Joint Box, FDMS	FAT/ITP	II
N.06	IMPS	FAT/ITP	IV
N.07	Optical bypass switch	FAT/ITP	IV
N.08	Air Purifier	FAT/ITP	I
N.09	Patch cord & connector	FAT/ITP	I
N.10	NMS	FAT/ITP	IV
N.11	OPGW Cable	MQP/ITP/FAT	III
N.12	Hardware Fittings for OPGW cable	MQP/ITP	III
N.13	DCPS	FAT/ITP	III
N.14	Radio Links	FAT/ITP	III
N.15	SMPS based DC Power Supply (DCPS) system	FAT/ITP	III
N.16	WAMS (PMU & Accessories)	FAT/ITP	III
N.17	PUF Shelter	FAT/ITP	III
N.18	Aerial OFC/UGOFC/ADSS/FO Cable	FAT/ITP	III
N.19	DWDM	FAT/ITP	III
N.20	OTN	FAT/ITP	III
N.21	MPLS-TP Equipment	FAT/ITP	III
N.22	L2 Switch	FAT/ITP	III
N.23	IP-MPLS Router	FAT/ITP	III
N.24	HDPE Pipes	POWERGRID TS	II
N.25	Equipment Cabinets	POWERGRID TS	II
N.26	Main Distribution Frame	POWERGRID TS	I
N.27	Telephone system, EPABX, Telephone wires, Telephone sockets	POWERGRID TS	I
N.28	Fiber Optic Cable	MQP	III
N.29	Hardware Fittings for Fiber Optic cable	MQP	III
O.01	Re-rollers of MS/HT Angle Section and galvanized tower parts.	MQP	IV
O.02	Conductor	MQP	IV
O.03	Hardware fittings and Conductor & Earthwire Accessories	MQP	IV
O.04	Earth wire	MQP	IV

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
O.05	Insulator	MQP	IV
O.06	Bolts & Nuts of Gr 8.8 / 8	MQP	IV
O.07	Mono Pole	MQP	IV
O.08	Foundation Bolts and Anchor Bolts	POWERGRID TS	III
O.09	D-shackle/ Hanger / Links and associated Special bolt/nuts	MQP	III
O.10	Span Marker, Obstruction lights and Wind Measuring Equipment	POWERGRID TS	III
O.11	MS ROD rolled by Approved Re-roller of POWERGRID	MQP	III
O.12	MS ROD rolled by Approved steel producers of POWERGRID	POWERGRID TS	I
O.13	Spring Washers & Pack washers	POWERGRID TS	II
O.14	Bolts & Nuts Gr up to 5.6/5	POWERGRID TS	II
O.15	ACD & Barbed wire for ACD/Bird guard	POWERGRID TS	II
O.16	Danger Plate /Phase Plate / Number Plate / Circuit plate	POWERGRID TS	I
O.17	Sub Station Structure (lattice/pipe type)	MQP	III
O.18	Clamps & Connecters (including equipment connectors)	MQP	III
O.19	MS/ GI Flat, rod type, pipe type and other earthing material.	POWERGRID TS	II
O.20	Aluminium Tube & Busbar materials	POWERGRID TS	II
O.21	Pipe Type & Counter Poise Earthing	POWERGRID TS	II
O.22	Chemical and Mechanical Anchor Bolts	POWERGRID TS	I
O.23	Bird Flight Diverter	POWERGRID TS/FAT	II

For Equipment where requirement of MQP is envisaged, ITP/FAT will be followed If sourced from off shore. For items required in S/S or T/L or TELECOM/GA&C , same inspection level as specified shall be followed for all the cases.

*MICC for test and measuring equipment (inspection level I or II) shall be issued only after actual verification/ demonstration of satisfactory performance at site.

** Though level-2 items, CIP/MICC can be issued also on review of TCs and visual inspection of these item.

Annexure- M

MANUFACTURING QUALITY PLAN

	Manufacturers Details (Name, Works Address etc.)	Customer POWERGRID	Vendor's Code:	Item:	Q.P. No. Rev. No. Date:	Valid From: Valid Upto:

Sr. No.	Components / Operations & Description of Test	Type of check	Quantum of Check / Sampling with basis	Reference document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
A. Section: RAW MATERIAL INSPECTION													
B. Section : IN PROCESS INSPECTION													
C. Section: FINAL TESTING													
D. Section: PACKING & DISPATCH													

		Customer **POWERGRID**	**Vendor's Code:**	**Item:**	**Q.P. No.** **Rev. No.** **Date:**	**Valid From:** **Valid Upto:**

Code 1	Indicates place **where testing is planned** to be performed i.e. Inspection location	**Code 2**	Indicates **who has to perform the tests** i.e. Testing Agency
A	At Equipment Manufacturer's works	J	The Equipment Manufacturer
B	At Component Manufacturer's works	K	The Component Manufacturer
C	At Authorized Distributor's place	L	The Third Party
D	At Independent Lab	M	The Turnkey Contractor
E	At Turn Key Contractor's location		
F	Not specified		
Code 3	Indicates **who shall witness** the tests i.e. Witnessing Agency	**Code 4**	Review of Test Reports/Certificates
P	Component Manufacturer itself	W	By Equipment manufacturer during raw material/bought out component Inspection.
Q	Component Manufacturer and Equipment Manufacturer	X	By Contractor during product/process inspection
R	Component Manufacturer, Equipment Manufacturer and Contractor	Y	By POWERGRID during product/process inspection
S	Equipment Manufacturer itself	Z	By Contractor and/or POWERGRID during product/process inspection
T	Equipment Manufacturer and Contractor		
U	Equipment Manufacturer and/or Contractor and POWERGRID		
V	Third Party itself		
Code 5	Whether specific approval of sub-vendor / Component make is envisaged?	**Code 6**	Whether test records required to be submitted after final inspection for issuance of CIP/MICC
E	Envisaged	Y	Yes
	Not Envisaged	N	No

I **Outdoor IP Based PTZ Camera:**

S No	Minimum Specifications	
1)	**Salient features:**	
a)	The cameras shall be pure IP based, and the Camera shall be compliant to ONVIF standards.	
b)	The cameras shall have PAN, TILT and ZOOM facilities.	
c)	The cameras must be operative in automatic mode for switching from day mode to night mode depending on the ambient natural light intensity without having to manually operate.	
d)	The cameras shall have IP-66 Protection Class enclosures or better.	
e)	The camera shall be suitable for wall mounting, ceiling mounting, pole mounting and switchyard structure mounting. All accessories needed for the mounting shall be provided.	
f)	Presets: Minimum 64 nos.	
g)	The camera shall have a Motion Detection feature.	
2)	**Camera Interface:**	
a)	The camera communication port shall be interfaced with a Media Converter (Copper to Fiber)/ Ethernet switch to be provided in a junction box.	
3)	**Junction Box**	
a)	The junction box shall accommodate all the necessary equipment such as power converter / LIU / Media converter / Fiber patch cords etc. and shall be of industrial grade type suitable for permanent outdoor use.	
4)	**SPECIFICATIONS & FEATURES**	
a)	**Camera/Optics:**	
	Zoom	30x Optical zoom or better and 12x digital zoom or better
i)	Image sensor	1/2.8" CMOS
ii)	Effective Pixel	(PAL): 1920*1680 or better

iii)	Lens	Focal length = 4 mm ~ 130 mm or better,
vi)	Iris Control	Automatic with manual override
xiii)	Video Streams	Dual Stream: Primary stream: H.264 Secondary stream: H.264
b)	**Camera/Video:**	
i)	Available Resolution	Mainstream: 1920x1080/O.3-O.4MPx Sub Stream: 0.1-0.2MPx
ii)	Frame rate	Frames should be between 10-25 FPS,
iii)	Supported Protocols:	TCP, IPv4 / IPv6 compliant), NTP, UDP, Multicast(lGMP)
iv)	Security	Multiple user access with password protection
v)	Panning Range	Complete 360 degrees endless
vi)	Pan Speed	Variable 0.1 /sec 120 /sec
vii)	Tilting Range	Minimum 180 ^{0} Tilt Rotation (+/- 90 $^{0)}$
viii)	Preset Accuracy	+ 0.1 ^{0} or better
ix)	PTZ Tracking	The camera automatically pan, tilt & zoom to follow the moving object until the object stops or disappears from the monitored area.
c)	**Camera/Dome drive features:**	
i)	Video Motion Detection	To detect occurrence of motion in FOV of camera
d)	**Power Supply/Connector:** The camera should be supplied with suitable power supply cable as per Indian Standards.	
e)	**SDK/API kit for integration with Central VMS system:**	
	The Software Development Kit (SDK)/Application programming interface (API) for the Cameras shall be supplied by the vendor for integration with the central visual monitoring system and shall have the capabilities:	
	Network device discovery, live video streaming, Video capture configuration, video compression configuration, Event and metadata configuration, Rule management for alerts, Storage recording, PTZ camera control.	

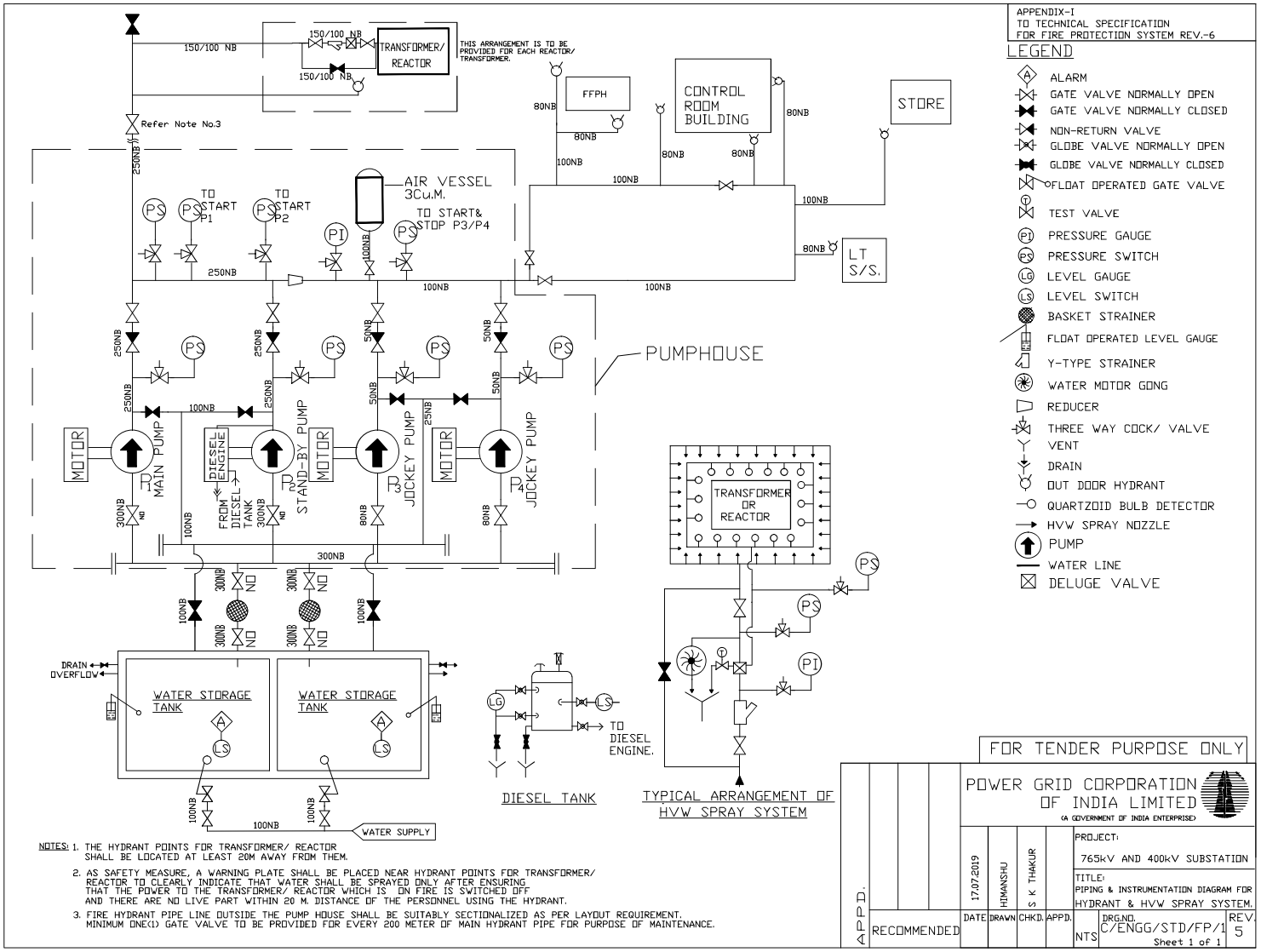
II. **NVR (Network Video Recorder):**

S No	Item	Characteristics
1	**Features**	
a	Processor	8 core or better
b	CPU/ Clock Speed	3.4GHz or better
c	RAM	DDR-3 or better, 8GB (2 x 4GB) or better
d	Hard Disk	The NVR should be supplied with at least 10 TB SAS based HDD from day-1.
e	Supports both IPv4 and IPv6	Yes
f	Supports SNMP v1, v2 and v3	Yes
2	**Interfaces:**	
a	I/O Ports	1 x Serial Port, 1 x Graphics, 1 x iLO Remote Manager shared with one Ethernet port
b	USB 3.0 Ports	02 nos.
c	Ethernet Port	01 no. (10/100/1000 Mbps)
d	Expansion Slots	PCIe Slots- 4nos
e	Operating System	Microsoft Windows latest version
f	Video Input	Minimum 10 channel
g	HDMI/VGA Output	HDMI – 01 no., VGA – 01 no.
h	Bandwidth Supported	Incoming minimum 50 Mbps; Outgoing minimum 40 Mbps
i	Recording Resolution	5MP or better 1080P or better
j	Protocols Supported	TCP/IP, ICMP, HTTP, DHCP, DNS, RTP, RTSP, RTCP, NTP, IGMP, QoS, IPV4, IPV6

III. POE Switch:

S No	Item	Characteristics
1	Interfaces:	• 16 nos. 10/100/1000 BASE-T based POE ports • 02 nos. SFP ports
2	Standards	IEEE 802.3u, 802.3af/at, 802.3ab, 802.3az, 802.3x
3	Power Requirements	150W (30 W max per PoE port)
4	Switching Capacity	01 Gbps

Note: The successful bidder shall supply camera along with a suitable Power Over Ethernet (PoE) Switch as per the above TS.



NOTES: 1. THE HYDRANT POINTS FOR TRANSFORMER/ REACTOR SHALL BE LOCATED AT LEAST 20M AWAY FROM THEM.

2. AS SAFETY MEASURE, A WARNING PLATE SHALL BE PLACED NEAR HYDRANT POINTS FOR TRANSFORMER/ REACTOR TO CLEARLY INDICATE THAT WATER SHALL BE SPRAYED ONLY AFTER ENSURING THAT THE POWER TO THE TRANSFORMER/ REACTOR WHICH IS ON FIRE IS SWITCHED OFF AND THERE ARE NO LIVE PART WITHIN 20 M. DISTANCE OF THE PERSONNEL USING THE HYDRANT.

3. FIRE HYDRANT PIPE LINE OUTSIDE THE PUMP HOUSE SHALL BE SUITABLY SECTIONALIZED AS PER LAYOUT REQUIREMENT. MINIMUM ONE(1) GATE VALVE TO BE PROVIDED FOR EVERY 200 METER OF MAIN HYDRANT PIPE FOR PURPOSE OF MAINTENANCE.

FOR TENDER PURPOSE ONLY

POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

APPD.	RECOMMENDED	DATE	DRAWN	CHKD.	APPD.
		17.07.2019	HIMANSHU	S K THAKUR	

PROJECT: 765kV AND 400kV SUBSTATION

TITLE: PIPING & INSTRUMENTATION DIAGRAM FOR HYDRANT & HVW SPRAY SYSTEM.

NTS | DRG.NO. C/ENGG/STD/FP/1 Sheet 1 of 1 | REV. 5

TECHNICAL DATA SHEETS

DATA SHEET FOR DELUGE VALVE

1.0	Manufacturer	POWERGRID Approved make
2.0	Number & size	As per approved system drawings.
3.0	Type	Differential Diaphragm type
4.0	Rating	
4.1	Flow in M^3/hr. 1. 150 mm ø 2. 100 mm ø	170 to 650 50 to 225
4.2	Pressure	Working Pressure – 12.3 kg/cm^2 Test Pressure - 25 kg/cm^2
4.3	Pressure drop in equivalent length 1. 150 mm ø 2. 100 mm ø	 19M 11M
5.0	**Material of construction**	
5.1	Body	CI IS:210 Gr. FG 260
5.2	Valve internal	Cast Bronze – IS:318-LTB 2 / Ductile Iron ASTM A536 65-45-12
5.3	Seat Seal	EPDM/ Neoprene Rubber
5.4	Diaphragm	EPDM/ Neoprene Rubber
6.0	Differential pressure required for operation	Differential Ratio – 50%
7.0	Water Motor Gong provided	Yes
7.1	Type	Hydraulic type
7.2	**Material of Construction:**	
7.2.1	Housing	Al. Alloy-IS:617
7.2.2	Cover/Rotor./Gong	Aluminium to IS:737
7.2.3	Manual actuation lever provided?	Yes
8.0	Remote actuation with Solenoid Valve provided?	Yes
9.0	Resetting type	Manual resetting type
10.0	Deluge valve complete with test and drain valves, manual operation arrangement, supporting structures and all necessary accessories	Yes
11.0	Approval of Deluge Valve.	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany

Annexure-S1

METHODOLOGY FOR SIZING OF CONTROL CABLES

S.No.	From	To	Cable size
1.	CB MB	CRP panels	i) 10CX2.5Sq mm ii) 19CX1.5 Sq mm iii) 27CX 1.5 Sq mm
2	CB MB	Earth switch MB	i) 3CX 2.5 Sqmm ii) 5C X2.5 Sq mm
3	Isolator MB	Earth switch MB	10CX1.5Sq mm
4	Isolator MB	CRP panels	19CX1.5 Sq mm
5	CT	CT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
6	CT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
7	CVT	CVT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
8	CVT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
9	LA	LA JB	3C X2.5 Sq mm
10	LA JB	CRP panels	5C X2.5 Sq mm
11	Reactor MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX1.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables
12	ICT MB/CMB (for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX1.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables

METHODOLOGY FOR SIZING OF POWER CABLES

S.No.	From	To	Existing Cable size	Cable type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm^2 :For each phase 1-1C X 630 mm^2 : for neutral	XLPE
2	Main Switch Board	AC Distribution Board	2-3½C X 300 mm^2	XLPE
3	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm^2	XLPE
4	Main Switch Board	Colony Lighting	1-3½C X 300 mm2	XLPE
5	Main Switch Board	HVW pump LCP	1-3½C X 300 mm2	XLPE
6	Main Switch Board	Main Lighting distribution board	2-3½C X 300 mm2	XLPE
7	AC Distribution Board	D.G. Set AMF Panel	For 500 kVA DG set: 2-3½C X 300 mm2 For 250 kVA DG set: 1-3½C X 300 mm2	XLPE
8	AC Distribution Board	Emergency Lighting distribution board	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	PVC
9	AC Distribution Board	ICT MB	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	PVC
10	AC Distribution Board	Bay MB	3½C X 70mm2 :For 765/400kV S/s 3½C X 35mm2 For 400/220kV S/s	PVC
11	Bay MB	AC Kiosk	1-4C X 16 mm2	PVC
12	AC Distribution Board	Battery Charger 220 V	1-3½C X 70 mm2	PVC
13	AC Distribution Board	Battery Charger 48 V	1-3½C X 35 mm	PVC
14	DCDB	Battery	2-1C X 150 mm2	PVC
15	DCDB	Battery Charger	2-1C X 150 mm2	PVC
16	DCDB	Protection/PLCC panel	1-4C X 16 mm2 : 765/400kV S/s 1-4C X 6 mm2: 400/220kV S/s	PVC
17	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm2	PVC

18	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm2	PVC
19	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm2	PVC
20	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm2	PVC
21	Lighting Panel	Sub lighting panels	These Cables shall be included in Price of item for Lighting fixture	PVC
22	Lighting Panel	Street Lighting Poles	These Cables shall be included in Price of item for Lighting fixture	PVC
23	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	These Cables shall be included in Price of item for Lighting fixture	PVC
24	Bay MB	Equipment	1-4C X 16 mm^2 : For CB 1-4C X 6 mm^2: For Isolator/earths switch 1-2C X 6 : For CT/CVT	PVC
25	ELDB	Lighting panel	3½C X 70mm^2 :For 765/400kV S/s 3½C X 35mm2 :For 400/220kV S/s	PVC

AIR CONDITIONING & VENTILATION SYSTEM FOR GIS BUILDING

AIR CONDITIONING SYSTEM FOR GIS

1. GENERAL

1.1. This specification covers supply, installation, testing and commissioning and handing over to POWERGRID of Air conditioning system for the Local Control rooms & Maintenance Room in the GIS halls.

1.2. Air conditioning system shall be designed to maintain the inside DBT below 24oC. Bidder shall submit necessary design calculations for employer's approval.

1.3. At least 50% spare Air-Conditioning capacity shall be provided for Local Control rooms in the GIS halls.

1.4. Controllers shall be provided in Local Control room inside GIS hall for controlling and monitoring the AC units in these rooms as detailed in clause no.2.6.

1.5. Each Local Control room inside GIS hall shall be provided with temperature transducer to monitor the temperature of the Local Control rooms in the GIS halls. The Temperature transducer shall have the following specification.

Sensor	: Air temperature sensor (indoor use)
Output	: 4 to 20mA
Temperature range	: -5°C to 60°C
Resolution	: 0.1^{o}C
Accuracy	: 0.5^{o}C or better.

2. AIR CONDITIONING SYSTEM REQUIREMENTS.

2.1. Air conditioning requirement of the buildings shall be met using a combination of following types Air Conditioning units as required.

a) Cassette type split AC units of 3TR.
b) High wall type split AC units of 2TR

2.2. Type & Capacity of air conditioners shall be so chosen such that quantity of air conditioners in the room is optimized keeping the necessary air flow.

2.3. SCOPE

The scope of the equipment to be furnished and services to be provided under the contract are outlined hereinafter and the same is to be read in conjunction with the provision contained in other sections/ clauses. The scope of the work under the contract shall be deemed to include all such items, which although are not specifically mentioned in the bid documents and/or in Bidder's proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation.

2.3.1. Required number of Cassette type split AC units of 3TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor unit with cordless remote controller.

2.3.2. Required number of High wall type split AC units of 2TR capacity each complete with air cooled outdoor condensing unit having hermetically sealed compressor and high wall type indoor evaporator unit with cordless remote controller.

2.3.3. Copper refrigerant piping complete with insulation between the indoor and outdoor units as required.

2.3.4. First charge of refrigerant and oil shall be supplied with the unit.

2.3.5. GSS/Aluminium sheet air distribution ducting for distributing conditioned dehumidified air along with supply air diffusers and return air grilles with volume control dampers and necessary splitters etc., suitable fixtures for grilles/diffusers and supports for ducting complete with insulation.

2.3.6. Local start/stop facility for local starting/ stopping of all electrical equipment/ drives.

2.3.7. All instruments and local control panels alongwith controls and interlock arrangements and accessories as required for safe and trouble free operation of the units.

2.3.8. PVC drain piping from the indoor units upto the nearest drain point.

2.3.9. Supply and erection of Power and control cable and earthing.

2.3.10. MS Brackets for outdoor condensing units, condensers as required.

2.4. Technical specifications

2.4.1. Cassette type split AC units

The Cassette type AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

2.4.1.1. Outdoor unit shall comprise of hermetically/ semi hermetically sealed compressors mounted on vibration isolators, fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal discharge of air.

2.4.1.2. Indoor units shall be of 4-way, ceiling mounted cassette type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi function cordless remote control unit with special features like programmable timer, sleep mode etc.

2.4.1.3. Cooling capacity of 3TR AC units shall not be less than 36000btu/hr. and shall have energy efficiency rating of 4 star as on the date of NOA.

2.4.2. **High wall type split AC units.**
The split AC units shall be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

2.4.2.1. Outdoor unit shall comprise of hermetically/semi hermetically sealed compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils all assembled in a sheet metal casing. The casing and the total unit shall be properly treated and shall be weatherproof type. They shall be compact in size and shall have horizontal discharge of air.

2.4.2.2. The indoor units shall be high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by suitable motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi function cordless remote control unit with special features like programmable timer, sleep mode and soft dry mode etc.

2.4.2.3. Cooling capacity of 2TR AC units shall not be less than 22000btu/hr. and shall have energy efficiency rating of 4 star as on the date of NOA

2.5. Controllers shall be provided in Local Control room inside GIS hall, one controller for each room, to control and monitoring of AC units and shall have the following facilities.

- Standby units shall come in to operation automatically when the running main unit fails.
- Main and standby units shall be changed over periodically which shall be finalised during detailed engineering.
- Following alarms shall be provided:

a. Compressor On/OFF condition of each unit
b. Compressor failure of each unit
c. Power OFF to AC unit
d. High temperature in room

2.6. Warranty
All compressors shall have minimum 5 years Warranty from the date of commissioning.

Ventilation system for GIS Hall

Each GIS Hall shall have an independent ventilation system. Each Ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

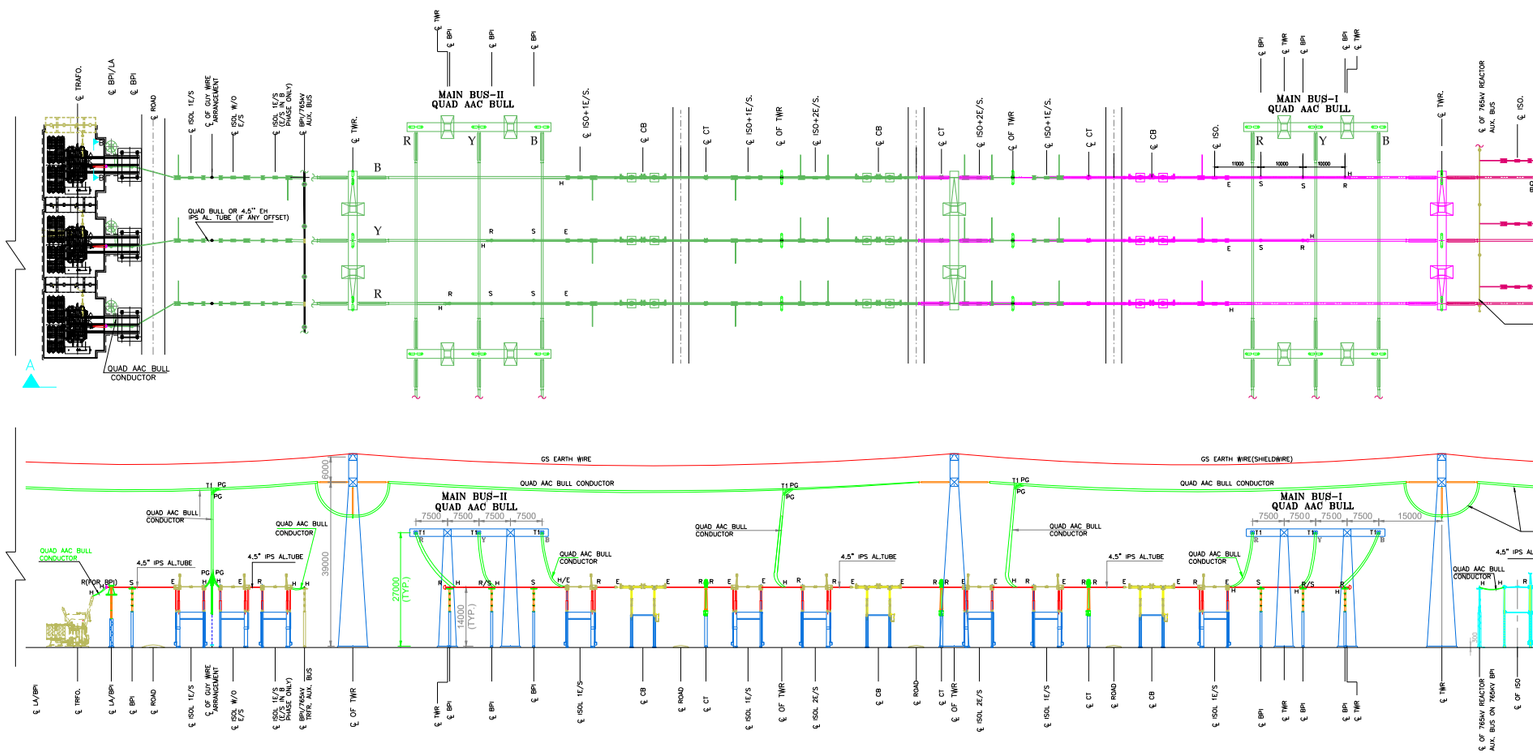
To ensure that the air being supplied to the GIS hall is free from dust particles, a minimum two stage dust filtration process shall be supplied. This shall consist of at least the following:

1. Pre Filters: To remove dust particles down to 10 micron in size with at least 95% efficiency.

2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency.

All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

The ventilation of the GIS hall shall be of a positive pressure type with minimum 2 air changes per hour. The pressure inside the GIS hall shall be maintained 5 mm of water above the atmospheric pressure. Fresh outdoor air shall be filtered before being blown into the GIS hall by the air fans to avoid dust accumulation on components present in the GIS hall. GIS hall shall be provided with motorized exhaust dampers with local control.



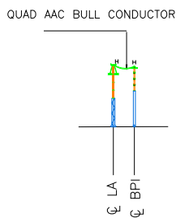
SECTION A–A (TYPICAL PLAN & SECTION FOR 765kV SIDE OF 765/400/33kV ICT –TIE–765kV LINE WITH

LEGENDS:

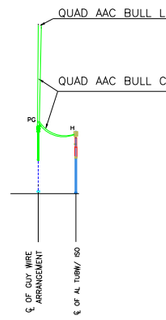
R– RIGID CONNECTION
E– EXPANSION TYPE CONNECTION
S– SLIDING TYPE CONNECTION
PG–PARALLEL GROOVE CONNECTION
T1– T1 TYPE CONNECTION (EACH T CONNECTOR SHALL BE OF TWIN TO TWIN CONDUCTOR TYPE FOR QUAD TO QUAD CONNECTION)
H– HORIZONTAL TYPE CONNECTION

NOTES:

1) TWIN–TWIN CONNECTOR SHALL BE USED FOR QUAD–QUAD DROPPER CONNECTION.
2) AUXILIARY BUS ARRANGEMENT FOR 765kV TRANSFORMERS & REACTOR NEUTRALS, SPARE TRANSFORMER/REACTOR CONNECTION, TERTIARY ARRANGEMENT OF TRANSFORMERS ARE NOT SHOWN COMPLETELY.
3) CANTILEVER STRENGTH OF 765KV INSULATORS/BPI USED FOR 765KV ISOLATORS/WT SHALL BE OF 10KN AND FOR OTHER BPI IN SWITCHYARD SHALL BE OF 8KN MINIMUM.
4) HORIZONTAL TAKE–OFF OF JUMPERS AT EQUIPMENT LEVELS WITH ADEQUATE SAG SHALL BE PROVIDED



SECTION B–B



SECTION C–C

ANNEXURE- S4

SHORT CIRCUIT FORCES & SPACER SPAN FOR 765kV & 400kV GANTRY STRUCTURE

For new 765kV and 400 kV AIS switchyard with one & a half breaker switching scheme, three gantry type arrangement (i.e. arrangement having single gantry in Tie bay) shall be considered. Further, Short-Circuit Forces (SCF) for the design of Gantry Structure and spacer spans shall be as mentioned below:

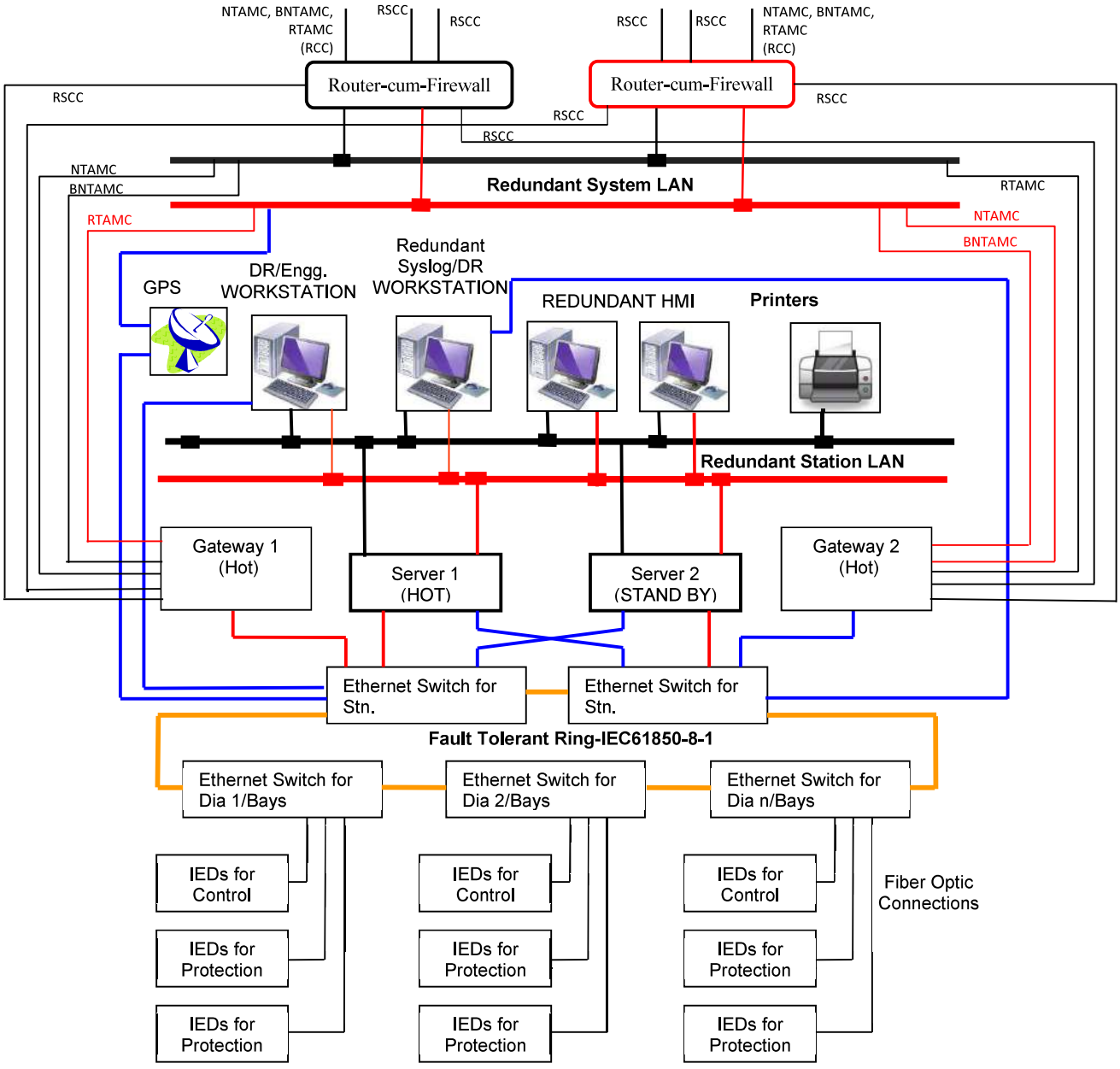
Voltage Level: 765kV, Fault Level: up to 50kA for 1 sec								
Bus Type	**Height of Bus (from FGL)**	**Max Span**	**Bus Conductor Configuration**	**Ph-Ph Spacing**	**Normal Tension per phase**	**SCF per phase**	**Spacer Span**	**Applicable Wind Speed**
Main Bus	27 Mtr	108 Mtr	Quad Bull	15Mtr	8T	9.75T	6Mtr	Upto 50m/s
Jack Bus	40 Mtr	140 Mtr		15Mtr	9.5T	11.26T	6Mtr	Upto 50m/s
Jack Bus	40 Mtr	114 Mtr		15Mtr	9.5T	11.10T	6Mtr	Upto 50m/s
Voltage Level: 400kV, Fault Level: up to 63kA for 1 sec, Bay Width : 24 Mtr								
Bus Type	**Height of Bus (from FGL)**	**Max Span**	**Bus Conductor Configuration**	**Ph-Ph Spacing**	**Normal Tension per phase**	**SCF per phase**	**Spacer Span**	**Applicable Wind Speed**
Main Bus	15mtr	72.0Mtr	Quad Bersimis	6.5mtr	5T	7.32T	4Mtr	Upto 50m/s
Jack Bus	23Mtr	75.0Mtr		6.5mtr	5T	7.36T	4Mtr	Upto 47m/s
Jack Bus	23Mtr	75.0Mtr		6.5mtr	5T	7.36T	3.5Mtr	Upto 50m/s
Jack Bus	23Mtr	59.0Mtr		6.5mtr	5T	7.12T	4Mtr	Upto 50m/s
Jack Bus	23Mtr	46.0Mtr		6.5mtr	4T	6.20T	4Mtr	Upto 50m/s

Above shall also be applicable for following cases unless otherwise specified elsewhere:

(i) Extension of 765kV switchyard with existing three gantry type arrangement
(ii) Extension of 400kV switchyard with existing three gantry type arrangement and having bus heights matching with above.

For design of gantry structures with spans, wind speed or conductor configurations other than that mentioned above, conductor tension shall be considered based on actual requirement of present & future scope of work. Relevant design calculations for such cases shall be submitted by the contractor for employer's approval.

TYPICAL ARCHITECTURAL DRAWING OF SUBSTATION AUTOMATION SYSTEM (Without Process Bus) for New Substation



Note:

1. The redundant managed bus (station LAN) shall be realized by high speed optical bus using industrial grade components and shall be as per IEC 61850.
2. Inside the sub-station, all connections shall be realized as per IEC 61850 protocol.
3. For gateway, it shall communicate with Remote Supervisory Control Centre (RSCC) on IEC 60870-104 protocol. The number of ports required shall be as per clause no. 1.1 and 3.3 of this specification.
4. The printer as required shall be connected to station bus directly and can be managed either from station HMI, HMI view node or disturbance recorder work stations.
5. The above layout is typical. However if any contractor offers slightly modified architecture based on their standard practice without compromising the working, the same shall be subject to approval during detailed engineering.
6. RCC means NTAMC/RTAMC. Similarly, RSCC could be SLDC for state owned substations/bays.
7. Syslog server to be Linux based. However DR/Engg. PC workstation can be other Operating System.

SPECIFICATION FOR SWITCHES

Substation System LAN:

2 (two) nos. managed Ethernet switches with 16 copper 10/100 Mbps RJ45 ports on each switch shall be supplied to form redundant system LAN as shown in typical architecture drawing. These switches shall be different from IEC 61850 LAN and specifically used for the purpose of connecting various devices of different sub-systems (SCADA, VMS, VOIP etc.) for integration with NTAMC/RTAMC. These switches shall be suitable for substation environment and shall comply with the requirements of IEC 61850-3 standard for EMI/EMC.

These LAN switches shall have the following compliance and functional features:

(a) Compliance as per NERC-CIP-3, NERC-CIP-5. NERC-CIP-7 standard for cyber security
(b) Support SNMPv3 (Full SNMP support including Traps)
(c) Web based GUI or CLI based with HTTPS/HTTP and SSH/ Telnet support
(d) Support for IPv4 and IPv6 switching simultaneously
(e) Layer 3 Static routing functionality
(f) Syslog facility for local as well as remote server
(g) Support for remote management
(h) LED indication for port status/supply etc.
(i) Shall support VLAN IEEE 802.1Q
(j) IGMP snooping
(k) Spanning tree protocol IEEE 802.1d or RSTP IEEE 802.1w
(l) Shall support SNTP
(m) Port based Network Access Control (IEEE 802.1x)
(n) Quality of Service (IEEE 802.1p)
(o) Shall support unicast as well as multicast IP traffic
(p) SNTP time synchronization
(q) Shall support Mac Binding
(r) Fanless design

Annexure-S7

Technical Specification for Next Generation Firewalls (NGFW)

1. NGFW shall have following features including but not limited to:
   Encryption through IPSec VPN (Virtual Private Network), Deep Packet Inspection (DPI), Denial of service (DoS) & Distributed Denial of Service (DDoS) prevention, Port Block/ Allow, rules/ policies for block/allow, IP (Internet Protocol) & Media Access Control (MAC) spoofing protection, threat detection, Intrusion Prevention System (IPS), Anti-Virus, Anti-Spyware, Man In The Middle (MITM) attack prevention.

2. The proposed firewall shall be able to handle (alert, block or allow) unknown /unidentified applications e.g. unknown TCP & UDP packets. It shall have the provision to define application control list based on application group and/or list.

3. Firewall shall have feature and also have capability to update the definition/ Signatures of Anti-Virus online as well as offline. Firewall shall also be compatible to update the definitions/signatures through CMC. There shall be a defined process for security patching and firmware up-gradation. There shall be a feature to field validate firmware checksum. The same shall also be validated before using the OEM provided file/binary in the process of firmware up-gradation and security patching

4. Firewall shall have Management Console port to configure remotely.

5. Firewall shall be EMI/EMC compliant in Substation environment as per IEC 61850-3.

6. Firewall shall be rack mounted in existing standard equipment cabinets.

7. Firewall shall have support of SCADA applications (IEC-60870-5-104), ICCP, PMU (IEEE C37.118), Sub-Station Automation System (IEC 61850), Ethernet and other substation environment protocols.

8. Client based Encryption/ VPN must support different Operating System platforms e.g. Windows, Linux & Mac.

9. The solution must have content and comprehensive file detection policies, blocking the files as function of their types, protocols and directions.

10. Firewall shall have logging facility as per standard logs/events format. Firewall shall have features to export the generated/stored logs/events in csv (Comma Separated Value) and also any other standard formats for offline usage, analysis and compliance. Firewall shall have suitable memory architecture and solution to store and be enable to export all logs/events for a period of last 90 days at any given time.

11. Firewall shall have features and be compatible with local as well as central authentication system (RADIUS, LDAP, or TACACS+) for user account and access right management. It shall also have Role Based User management feature.

12. Firewall shall have the capability to configure sufficient number of VLANs.

13. Firewall shall have the capability to support sufficient number of sessions.

14. Firewall shall have provision to configure multiple IP Sec VPNs, at least 100 nos., (one-to-many or many-to-one). Shall support redundant operation with a similar router after creation of all the IP Sec VPN. IPSec VPN shall be with encryption protocols as AES128, AES256 and hashing algorithms as MD5 and SHA1. IPSec VPN throughput shall be at least 300 Mbps.

15. Firewall shall be capable of SNMP v3 for monitoring from Network Management system. It shall also have SNMPv3 encrypted authentication and access security.

16. Firewall shall operate in Active/Passive or Active-Active mode with High Availability features like load balancing, failover for firewall and IPsec VPN without losing the session connectivity.

17. Firewall should have integrated traffic shaping (bandwidth, allocation, prioritisation, etc.) functionality.

18. Shall support simultaneous operation with both IPv4 and IPv6 traffic.

19. Firewall shall be compatible with SNTP/NTP or any other standards for clock synchronization.

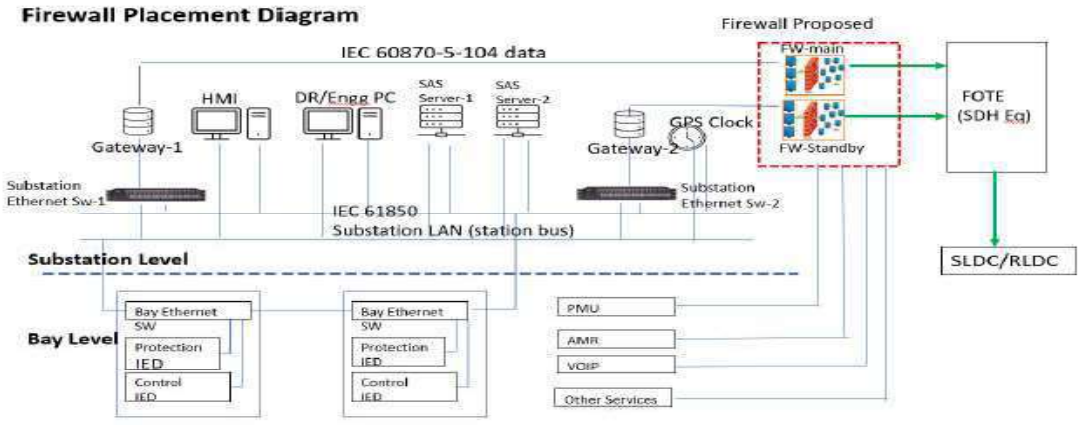
20. Firewall shall have the features of port as well as MAC based security.

21. Firewall shall support exporting of logs to a centralized log management system (e.g. syslog) for security event and information management.

22. Firewall time shall be kept synchronised to official Indian Timekeeping agency, time.nplindia.org.

23. Firewall product shall be provided with all applicable updates at least until 36 months since the applicable date of product shipping to the concerned utility.

Figure-I



SPECIFICATION FOR DIGITIAL PROTECTION COUPLER

1.0 Digital protection coupler for protection signalling through optical fibre cablesystem

1.1 The Digital protection signalling equipment is required to transfer the trip commands from one end of the line to the other end in the shortest possible time with adequate security and dependability. It shall also monitor the healthiness of the link from one end to the other and give alarms in case of any abnormality. The protection signalling equipment shall have a proven operating record in similar application over EHV systems and shall operate on 48V DC (+15%/-20%). It shall provide minimum four commands. These commands shall be suitable for Direct tripping, Intertripping and Blocking protection schemes of EHV lines.

The protection signalling equipment shall communicate to the remote end interfacing with SDH terminal equipment at its 2Mbps port. It shall provide suitable interfaces for protective relays, which operate at 220V DC. Power supply points shall be immune to electromagnetic interface

1.2 Principle of operation

During normal operation, protection signalling equipment shall transmit a guard signal/code. In case Protection signalling equipment is actuated by protective relays for transmission of commands, it shall interrupt the guard signal/code and shall transmit the command code to the remote end. The receiver shall recognize the command code and absence of the guard code and will generate the command to the protective relays.

All signal processing i.e. generation of tripping signal and the evaluation of the signals being received shall be performed completely digital using Digital Signal Processing techniques.

1.3 Loop testing

An automatic loop testing routine shall check the teleprotection channel.

It shall also be possible to initiate a loop test manually at any station by pressing a buttonon the front of the equipment.

Internal test routine shall continuously monitor the availability of the protection signaling equipment.

Proper tripping signal shall always take the priority over the test procedure.

The high speed digital protection signalling equipment shall be designed and provided with following feature.

- Shall work in conjunction with SDH terminal equipment.
- It shall communicate on G 703 (E1,2 Mbps)
- Full Duplex operation
- Auto loop facility shall be provided
- Shall meet IEC 60834-1 standard
- Shall be able to transmit upto 4 commands with trip counter simultaneouslyor sequentially in one 2Mbps channel

Bidder shall quote for protection signalling equipment suitable for 4 commands with separate trip counters for transmit and receive. With regard to trip counters alternate arrangement .i.e. Laptop along with software & all accessories to download eventsincluding carrier receipt and transmit shall be acceptable. Laptop for the above shall be supplied at each substation under substation package.

High security and dependability shall be ensured by the manufacturer. Probability of false tripping and failure to trip shall be minimum. Statistical curves/figures indicating above mentioned measures shall be submitted along with the bid.

The DPC can be either housed in offered Control & Protection Panel / PLCC Panel or in separate panel.

Reports of the following tests as per clause 9.2 of Section-GTR shall be submitted for approval for protection signalling equipment and relays associated with the protection signalling equipment and interface unit with protective relay units, if any.

i) **General equipment interface tests:-**

a) Insulated voltage withstand tests
b) Damped oscillatory waves disturbance test
c) Fast transient bursts disturbance test
d) Electrostatic discharge disturbance test
e) Radiated electromagnetic field test
f) RF Disturbance emission test

ii) **Specific power supply test**

a) Specific power supply test
b) Power supply variations
c) Interruptions
d) LF disturbance emission
e) Reverse polarity

iii) **Tele-protection system performance test:-**

a) Security
b) Dependability
c) Jitter
d) Recovery time
e) Transmission time
f) Alarm functions
g) Temperature and Humidity tests (As per IEC 68-2)

- Dry heat test (50°C for 8 hours
- Low temperature test (-5°C for 8 hours)
- Damp heat test (40°C/95%RH for 8 hours

All the above tests at i, ii & iii (except temperature & humidity tests) shall be as per IEC

60834-1 and the standards mentioned therein.

iv) **Relays**

a) Impulse voltage withstand test as per clause 6.1 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686

b) High frequency disturbance test as per clause 5.2 of IS:8686 (for a test voltage appropriate to clause III as per clause 3.2 of IS:8686).

The protection signalling equipment shall be of modular construction and preferably mounted in the Relay panels. Cabling between the protection signalling equipment & Protection relays and between protection signalling equipment & Communication equipment shall be in the scope of bidder.

The input/output interface to the protection equipment shall be achieved by means of relays and the input/output rack wiring shall be carefully segregated from other shelf/cubicle wiring.

The isolation requirements of the protection interface shall be for 2kV rms.

1.4 Major technical Particulars

The major technical particulars of protection signalling equipment shall be as follow.

i) Power supply 48V DC +15% /-20%

ii) Number of commands 4 (four)

iii) Operating time <7 ms

iv) Back to back operate time without propagation delay ≤ 8 ms

v) Interface to Protection relays

Input: Contact Rating:

Rated voltage : 250 volts DC

Maximum current rating: 5 amps

Output: Contact Rating:

Rated voltage : 250 volts DC

Rated current : 0.1 A DC

Other parameters : As per IEC-255-0-20

vi) Alarm contact

Rated voltage : 250 volts DC

Rated current : 0.1 A DC

Other parameters : As per IEC-255- 0-20

vii) Digital communication interface: G 703(E1

Technical Specification for Visual monitoring system for watch and ward of Substation premises:

Visual monitoring system (VMS) for effective watch and ward of sub station premises covering the areas of entire switchyard, Control Room cum Administrative building, Fire fighting pump house, stores and main gate, shall be provided. The contractor shall design, supply, erect, test and commission the complete system including cameras, Digital video recorder system, mounting arrangement for cameras, cables, LAN Switches, UPS and any other items/accessories required to complete the system. To provide all the necessary licenses to run the system successfully shall be in the scope of contractor.

System with Color IP Cameras for VMS surveillance would be located at various locations including indoor areas and outdoor switchyard and as per the direction of Engineer-In-Charge. The VMS data partly/completely shall be recorded (minimum for 15 days) and stored on network video recorder.

The number of cameras and their locations shall be decided in such a way that any location covered in the area can be scanned. The cameras shall be located in such a way to monitor at least:

1. The operation of each and every isolator pole of the complete yard in case of AIS Sub-station.
2. The Operation of each bay(s) of GIS Hall as Applicable.
3. All the Transformer and Reactors All the Entrance doors of Control Room Building and Fire-fighting Pump House, GIS Hall and Switchyard Panel room as applicable.
4. All the gates of switchyard.
5. Main entrance Gate
6. All other Major AIS Equipment (such as CB, CT, CVT, SA etc. as applicable)

   The cameras can be mounted on structures, buildings or any other suitable mounting arrangement to be provided by the contractor.

1.1 Technical requirements of major equipment of Visual Monitoring System.

1.1.1 The Video Monitoring system shall be an integrated system with IP network centric functional and management architecture aimed at providing high-speed manual/automatic operation for best performance.

1.1.2 The system should facilitate viewing of live and recorded images and controlling of all cameras by the authorized users.

1.1.3 The system shall use video signals from various types of indoor/outdoor CCD colour cameras installed at different locations, process them for viewing on workstations/monitors in the control Room and simultaneously record all the cameras after compression using **H 264**/MPEG 4 or better standard. Mouse/Joystick-Keyboard controllers shall be used for Pan, Tilt, Zoom, and other functions of desired cameras.

1.1.4 The System shall provide sufficient storage of all the camera recordings for a period of 15 days or more

@ 25 FPS, at 4 CIF or better quality using necessary compression techniques for all cameras. It shall be ensured that data once recorded shall not be altered by any means. The recording resolution and frame rate for each camera shall be user programmable.

1.1.5 The surveillance VMS System shall operate on 230 V, 50 Hz single-phase power supply. System shall have back up UPS power supply meeting the power supply need of all the cameras in the stations including those which are installed at gate for a period of 2 hours. The bidder shall submit the sizing calculation for the UPS considering the total load requirement of Video Monitoring System.

1.2 System requirements:

a) System must provide built-in facility of watermarking or Digital certificate to ensure tamperproof recording.

b) All cameras may be connected through a suitable LAN which shall be able to perform in 765kV class sub-station environment without fail.

c) All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password.

d) Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

e) Facility of Camera recording in HD (1280X720p), D1 , 4CIF , CIF, VGA, as well as in any combination i.e. any camera can be recorded in any quality.

f) System to have facility of **100%** additional camera installation beyond the originally planned capacity.

g) In order to optimize the memory, while recording, video shall be compressed using H **264**/MPEG-4 or better standard and streamed over the IP network.

h) System shall be triplex i.e. it should provide facility of Viewing, Recording & Replay simultaneously.

i) The offered system shall have facility to export the desired portion of clipping (from a specific date/time to another specific date/time) on CD or DVD. Viewing of this recording shall be possible on standard PC using standard software like windows media player etc.

j) System shall have provision of WAN connectivity for remote monitoring.

k) The equipment should generally conform to Electro magnetic compatibility requirements for outdoor equipment in EHV switchyards. The major EMC required for Cameras and other equipment shall be as under:

1. Electrical Fast Transient (Level 4) – As per IEC 61000-4-4
2. Damped Oscillatory (1 MHz and 100 KHz) (level 3) – As per IEC 61000-4-18
3. AC Voltage Dips & Interruption/Variation (class 3) – As per IEC 61000-4-11
4. Electrostatic Discharge (Level 4) – As per IEC 61000-4-2
5. Power Frequency Magnetic Field (level 4) – As per IEC 61000-4-8
6. Ripple on DC input Power Supply Port immunity test(level 4) - As per IEC 61000-4-17

Type test reports to establish compliance with the above requirement shall be submitted during detailed engineering.

1.2.1 VIDEO SURVEILLANCE APPLICATION SOFTWARE

a) Digital video surveillance control software should be capable to display and manage the entire surveillance system. It should be capable of supporting variety of devices such as cameras, video encoder, Servers, NAS boxes/Raid backup device etc.

b) The software should have inbuilt facility to store configuration of encoders and cameras.

c) The software should Support flexible 1/2/4/8/16/32 Windows Split screen display mode and scroll mode on the PC monitor.

d) The software should be able to control all cameras i.e. PTZ control, Iris control, auto / manual focus, and color balance of camera, Selection of presets, Video tour selection etc.

e) The software should have user access authority configurable on per device or per device group basis. The system shall provide user activity log with user ID, time stamp, action performed, etc.

f) The users should be on a hierarchical basis as assigned by the administrator. The higher priority person can take control of cameras, which are already being controlled by a lower priority user.

g) It should have recording modes viz. continuous, manual, or programmed modes on date, time and camera-wise. All modes should be disabled and enabled using scheduled configuration. It should also be possible to search and replay the recorded images on date, time and camera-wise. It should provide onscreen controls for remote operation of PTZ cameras. It should have the facility for scheduled recording. Different recording speeds (fps) and resolution for each recording mode for each camera should be possible.

h) The software for clients should also be working on a browser based system for remote users. This will allow any authorized user to display the video of any desired camera on the monitor with full PTZ and associated controls.

i) Retrieval: The VMS application should allow retrieval of data instantaneously or any date / time interval chosen through search functionality of the application software. In case data is older than 15 days and available, the retrieval should be possible. The system should also allow for backup of specific data on any drives like DVD's or any other device in a format which can be replayed through a standard PC based software. Log of any such activity should be maintained by the system.

j) VMS shall provide the full functionality reporting tool which can provide reports for user login/logoff, camera accessibility report, server health check reports etc.

1.2.2 Network video recorder

The Network Video recorder shall include at least Server (min 3.0 GHZ, 4GB RAM, 3000GB HDD(min)), RAID 5 ,with suitable configuration along with Colored TFT 22" High resolution monitor, and Internal DVD writer. Windows XP/Vista/7 Prof. or VMS compatible operating system latest version with hardware like graphic cards, licensed Anti-virus etc.

Further the digital video recorder shall conform to the following requirements:

1.	Server Spec	Intel Quad Core (or better) 3.0 Ghz (min.) , 8 MB Cache , 4 GB memory , with suitable NVIDIA graphics card,3 TB HDD , Raid 5
2.	Recording and Display Frame Rate	Real-time 25 frames per second per channel , manual select

3.	Recording Resolution	(PAL): 1280X720 , 704(H) x 586(V) It should be possible to select lower resolutions
4.	Compression Method	H.264/MPEG-4 or better and latest
5.	Video Motion Detection Capable	Standard and built-in (selectable in menu)
6.	Monitoring Options	Split screen 1, 2, 4 , 8, 16, 32 or more cameras
7.	Playback Options	Search, still image capture
8.	Alarm/Event Recording Capable	To be provided with built-in external alarm input/ output ports minimum(8 in, 2 out)
9.	Network Operation Capable	To be provided by using WAN or LAN router
10.	Remote Internet Viewing Capable	Using WAN or LAN router
11.	HDD Storage Consumption	1GB ~ per hour / channel variable based on frame speed and resolution settings, as well as compression
12.	Operation	Triplex operation (simultaneous recording, playback, network operation)
13.	Number of Video Channel	32
14.	Audio Recording Capable	32
15.	Input Voltage	230V AC or equivalent with UPS as a back up for 30 minutes.

1.2.3 VMS Camera

a) The color IP camera for substation shall have PAN, TILT and ZOOM facilities so that it can be focused to the required location from the remote station through a controller. Whereas wireless IP cameras with PTZ controls are required for installation at gates of the POWERGRID premises as per the direction of Engineer-In-Charge

b) The IP Camera at the main gate can be fixed or PTZ based and shall be used for monitoring entry and exit

c) It should have sufficient range for viewing all the poles of isolators and other equipments with high degree of clarity.

d) The VMS camera shall be suitable for wall mounting, ceiling mounting and switchyard structure mounting.

e) It shall be possible to define at 128 selectable preset locations so that the camera gets automatically focused on selection of the location for viewing a predefined location.

f) The camera should be able to detect motion in day & night environments having light intensity of Color: 0.5 Lux; B&W:0.05 Lux

g) Housing of cameras meant for indoor use shall be of IP 42 or better rating whereas outdoor camera housing shall be of IP 66 or better rating. Housing shall be robust and not have the effect of electromagnetic induction in 765/400KV switchyard.

h) All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. Camera ID, Location/Area of recording & date/time shall be programmable by the system administrator with User ID & Password

i) Facility of camera recording in real-time mode (25 FPS)/15/12.5/10 or lower FPS as well as in any desired combination must be available in the system.

A. Outdoor IP Fixed Megapixel Camera Specifications (For Main Gate)

1.	Image Sensor	2-megapixel Progressive ,1 / 3" CMOS/CCD sensor, Minimum illumination 0.1 Lux
2.	Min Luminous	0.5LUX(Color) 0.05Lux(Black)
3.	Camera Enclosure Type	IP66 Grade
4.	Iris/Focus	Auto/Manual
5.	Video Compression	Dual Stream H.264 and MPEG 4 user selectable
6.	Support Dual-stream	primary/secondary stream, H.264/MPEG 4 optional
7.	Video Definition	Primary stream:1600x1200,1280x960,1280x720, Secondary stream:800x600,400x288,192x144
8.	Video Parameters	Brightness, hue, contrast, saturation and image quality
9.	Video Frame Rate	PAL: 1-25frames/second NTSC:1-30frames/second
10.	Video Compression BR	32Kbit/S - 6Mbit/S
11.	Video Output	One channel composite Streaming
12.	Supported Protocols	TCP, UDP, IP, HTTP, FTP, SMTP, DHCP, DNS,ARP, ICMP, POP3, NTP, IPsec, UpnP, RTP, RTCP
13.	Operating Temperature	-5 ~ +50°C
14.	Operating Humidity	10 ~ 90%

B. Outdoor IP66 PTZ HD Camera Specifications (For Switch Yards)

1.	Image sensor	1/3 type Solid State Progressive Scan CCD,WDR(High Definition)
2.	Security	Multiple user access with password protection
3.	Effective Pixels	**(PAL): Main Stream：1280x720** Sub Stream：640x360、320x280 selectable
4.	Compression	Dual Stream H.264 and MPEG 4 user selectable
5.	Signal System	50 Hz
6.	S/N (signal to noise) Ratio	Better than 50 dB
7.	Electronic Shutter	1/60 ~ 1/10,000 sec. automatic or better
8.	Scanning System	Progressive/interlace
9.	Low Light Sensitivity (lux)	Color: 0.5 Lux; B&W:0.02 Lux
10.	Lens	Minimum 10x (minimum) optical in High Definition **(The system shall be able to zoom the images on the monitor without any distortion to the maximum level of optical zoom)**
11.	Lens Size	Minimum 4.1~73.8 mm
12.	Lens Aperture	F1.6(wide)~F2.8(tele), f=4.1~41.0mm, 10X Zoom, Video Auto Focus Angle of View Horizontal : 52°(wide) , 2.8°(tele)
13.	PTZ Data Transfer Baud/Bit Rates Supported	Selectable 2400 bps / 4800 bps / 9600 bps

14.	Panning Range	Complete 360 degrees (horizontal)
15.	Pan Speed	Adjustable, 0.1 degrees / second ~ 250 degrees / second
16.	Tilting Range	Minimum 180° Tilt Rotation
17.	Tilt Speed	Adjustable, 0.1 degrees / second ~ 150 degrees / second
18.	In Built Storage	Camera should have inbuilt storage TF or SD format for recording and storing Pictures
19.	IP Class	IP66 Standard
20.	Working temperature	-0℃ ~ +50℃
21.	Working Humidity	10 ~ 90%

1.2.4 PTZ-Keyboards

The features of PTZ shall include:

- Fully functional dynamic keyboard/joystick controllers
- Controls all pan, tilt, zoom, iris, preset functions
- Control up to 255 units from a single keyboard
- Many preset options and advanced tour programming
- Compatible with all connected cameras

1.	Key Application	wired keyboard control operation of PTZ functions for weatherproof dome cameras
2.	Pan / Tilt / Zoom Protocol Languages Supported	Selectable
3.	PTZ Data Transfer Baud Rates Supported	selectable 1200 bps / 2400 bps / 4800 bps / 9600 bps
4.	Additional Features	dynamic joystick for smooth camera movements, preset location option for quick access to frequently monitored areas

Annexure- S10

ANNEXURE-12

Of Section-GIS Rev 5A

Reference Guidelines for GIS Grounding

1. GIS Grounding

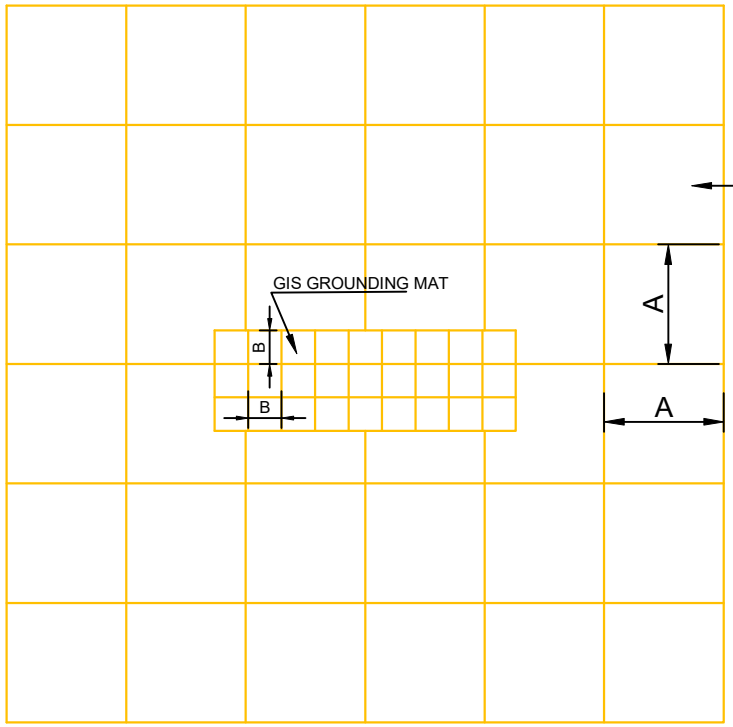
These reference guidelines are minimum requirement and do not override manufacturer's recommendations or design criteria. These Reference Guidelines shall be read and implemented in conjunction with manufacturer recommendation/Criteria for GIS grounding design.

GIS Grounding system shall be designed to provide low-impedance grounding path for ground fault currents. Very Fast Transient generated due to electrical breakdown in the insulating gas, either across the contacts of a switching device during operation or under fault conditions shall also need to be considered in the overall grounding design for GIS. Grounding conductors or system of conductors shall be provided for connecting all designated metallic components of gas-insulated substation (GIS) to a substation grounding system.

1.1. **Power Frequency Grounding**: Manufacturer recommended designated grounding points of GIS equipment shall be connected with the risers directly coming from buried main GIS grounding mat. The Size of the conductor (copper) for making this connection shall be submitted by GIS manufacturer based on the specified fault current and its duration. The location and numbers of above said risers shall be as per the manufacturer recommended designated grounding points for GIS equipment. Main GIS grounding mat shall be buried at the level of station grounding mat. It shall be made up of same conductor as that of station grounding mat. The spacing of main GIS grounding mat for different voltage levels of GIS shall be as per attached Typical Drawing.

1.2. **High Frequency Grounding of GIS equipment**: Dedicated copper grounding mesh with specified spacing and cross-section shall be provided at the top of GIS building finished floor level. This dedicated copper grounding mesh shall be spread-over, beneath complete GIS switchgears installation and extended up to 500 mm away in all direction from GIS switchgears installation. This dedicated copper grounding mesh shall be directly connected to the GIS enclosures (min. at two distant points in each phase/bay) and to the risers directly coming from GIS grounding mat (min. at two distant locations per phase/bay) with the shortest path to the connection point. All Crossing of copper grounding mesh shall be suitably clamped/welded together. Bolted joint at crossings is not allowed, further this copper grounding mesh shall be clamped adequately to the floor at suitable locations. At the jointing of two different metals the joint shall be made using requisite bi-metallic jointer. This dedicated copper grounding mesh is laid at the top of GIS floor and shall also be connected with dedicated grounding rod electrodes provided at a regular interval of not more than 12 meters around periphery of GIS building. This copper grounding mesh shall be laid after the GIS bays are place on the floor and shall be suitably covered with Non-Electrostatic rubber mats to avoid damage to mesh and to avoid hinderance in regular operation of equipment. The Spacing, conductor detail and cross-section of copper grounding mesh shall be as per attached Typical Drawing.

Typical Drawing No, Standard/GIS/GROUNDING/01 for above said grounding recommendation is part of this document.



A - TYPICAL SPACING FOR STATION GROUNDING MAT

B - TYPICAL SPACING FOR MAIN GIS GROUNDING MAT

C - COPPER GROUNDING MESH

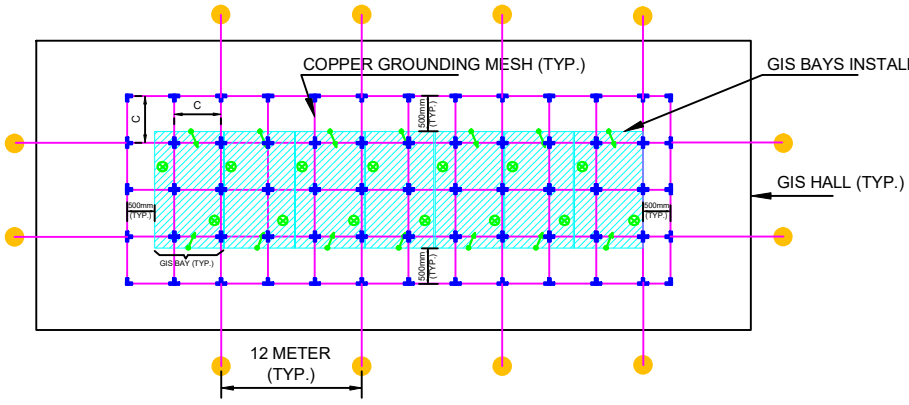
CONNECTION POINT OF COPPER GROUNDING MESH WITH GIS ENCLOSURE (TYP.)

CONNECTION POINT OF COPPER GROUNDING MESH WITH MAIN GIS GROUNDING MAT RISERS(75X12 MM GI FLAT) (TYP.)

COPPER CLAMP/ WELDED JOINT (TYP.)

3000mm LONG, 40mm DIA ROD ELECTRODE

	STATION GROUNDING MAT			MAIN GIS GROUNDING MAT			COPPER GROUNDING MESH			
VOLTAGE LEVEL	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR (TYP.)	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR (TYP.)	TYPICAL SPACING (MTRxMTR)	PLACEMENT AT (TYP.)	CONDUCTOR	CONDUCTOR CROSS SECTION
765kV	AS PER STATION GROUNDING DESIGN	600MM BELOW FGL	40MM DIA. MS ROD	5x5	600MM BELOW FGL	40MM DIA. MS ROD	5x5	GIS BUILDING FLOOR FFL	COPPER STRIP	50x6mm
400kV				3x3			3X3			50x6mm
220kV & 132kV				3x3			---			---



NOTES:-

1. THIS DRAWING SHALL BE REFEREED AS COLORED PRINT ONLY.
2. THESE REFERENCE GUIDELINES DO NOT OVERRIDE MANUFACTURER'S RECOMMENDATIONS OR DESIGN CRITERIA. THESE REFERENCE GUIDELINES SHALL BE READ AND IMPLEMENTED IN CONJUNCTION WITH MANUFACTURER RECOMMENDATION/CRITERIA FOR GIS GROUNDING DESIGN.
3. THE MAIN GIS GROUNDING MAT SHALL BE LAID BENEATH GIS BUILDING COVERING LENGTH AND WIDTH OF GIS BUILDING.
4. ANNEXURE FOR "REFERENCE GUIDELINES FOR GIS GROUNDING" ENCLOSED.

POWER GRID CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE: TYPICAL GIS GROUNDING REFERENCE GUIDELINES

DATE	DRAWN	SCALE	DRG.NO. STD/GIS/GROUNDING/01	REV
JAN 2023		NTS		0

DESCRIPTION OF GIS BAY MODULE & EQUIPMENTS

765kV Gas Insulated Switchgear (One & half breaker Scheme) 2
420kV Gas Insulated Switchgear (One & half breaker Scheme) 9
420 kV Gas Insulated Switchgear (Double Main Busbar Scheme) 15
245 kV Gas Insulated Switchgear (Double Main Busbar Scheme) 21
145 kV Gas Insulated Switchgear (Double Main Busbar Scheme) 24
Gas Insulated Outdoor Bus Duct (GIB): 27
Gas Insulated SF6 to Air Termination: 27
Gas Insulated SF6 to Oil Termination: 27
Gas Insulated SF6 to Cable Termination: 28
Gas Insulated Surge Arrester: 28

765kV Gas Insulated Switchgear (One & half breaker Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type & configuration of different GIS modules shall be as specified below:

i) **GIS Bus bar Module:**
Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 1-phase Potential Transformers.

v. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

vi. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece (interface) module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vii. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

viii. Local Control Cubicle (if required separately).

ii) **GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):**
Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

iii. Extension piece (Interface) module, as required to extend existing bus so as to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended .

iv. End Piece (Interface) modules with isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece (interface) module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers, 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. One (1) number 3-phase, single pole, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers single phase, SF6 ducts inside GIS hall (up to the outer edge of the wall of GIS Hall).

viii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc., as required.

ix. Local Control Cubicle.

'#' As per BPS

iv) GIS Tie Bay module:

SF6 gas-insulated metal enclosed Tie bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (#) with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

'#' As per BPS

v) GIS ICT Bay module:

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phase, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vi) GIS Bus Reactor Bay module:

SF6 gas insulated metal enclosed Bus Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Bus reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vii) GIS Switchable Line Reactor Bay module:

SF6 gas insulated metal enclosed Switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Line reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

vii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

viii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

ix. Local Control cubicle.

viii) GIS Line Reactor Bay module:

SF6 gas insulated metal enclosed Non-Switchable Line reactor bay module, each set comprising of the following:

i. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare Line reactor through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

vi. Local Control cubicle (if required separately).

ix) GIS Auxiliary Bus module for Spare ICT Connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

x) GIS Auxiliary Bus module Extension for Spare ICT connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

xi) GIS Auxiliary Bus module for Spare Reactor Connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for Reactor bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of Reactor with all Reactor Bay Modules through GIS Duct and provision of extension for future Reactors.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

vi. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

xii) GIS Auxiliary Bus module Extension for Spare Reactor connection:

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for Reactor bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of Reactor with all Reactor Bay Modules through GIS Duct and provision of extension for future Reactors.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

xiii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) Numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

420kV Gas Insulated Switchgear (One & half breaker Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

vii. Local Control Cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in one and a half breaker bus system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers, 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. One (1) number 3-phase, single pole, high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers single phase, SF6 ducts inside GIS hall (up to the outer edge of the wall of GIS Hall).

viii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc., as required.

ix. Local Control Cubicle.

'#' As per BPS

iv) GIS Tie Bay module:

SF6 gas-insulated metal enclosed Tie Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker (#) with/without PIR complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on other side of circuit breaker

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

'#' As per BPS

v) GIS ICT bay module (For 400kV side of 765/400kV ICT):

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phase, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase SF6, ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

vi) GIS Auxiliary Bus module for Spare ICT Connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number, single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Auxiliary Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vii) GIS Auxiliary Bus module Extension for Spare ICT connection (For 400kV side of 765/400kV ICT):

Set of isolated phase, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

viii) GIS ICT bay module (For 400kV HV side of 400/220kV ICT):

SF6 gas-insulated metal enclosed ICT bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

ix) GIS Bus reactor bay module:

SF6 gas insulated metal enclosed Bus reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

viii. Local Control cubicle.

x) GIS Line Reactor Bay module:

SF6 gas insulated metal enclosed Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

v. Local Control cubicle (if required separately).

xi) GIS Switchable Line reactor bay module:

SF6 gas insulated metal enclosed switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

vi. Local Control cubicle.

Note: Quantity of "3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms" and "3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms" shall be Two (2) nos. in case of direct connection of Line Reactor with GIS.

xii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

420 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three isolated phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) no's individual bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus so as to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension of Bus bar module on one side. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i One (1) number 3-phase, SF6 insulated circuit breaker (**#)** with/without PIR complete with operating mechanism.

ii Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi One (1) number 3-phase, single pole, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vii Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall)

viii Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

ix Local Control Cubicle.

'#' As per BPS

iv) GIS ICT bay module (For 400kV side of 765/400kV ICT):

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms.

vii. Three (3) numbers 1-phases, individual pole operated safety grounding switches, complete with manual and motor driven operating mechanisms.

viii. Three (3) numbers 1-phase, individual pole operated isolator switches, complete with manual and motor driven operating mechanisms for switching of Spare ICT through Auxiliary bus. The isolator must meet the operational requirement in terms of Phase-phase insulation withstand capability.

ix. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

x. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

xi. Local Control cubicle.

v) GIS Auxiliary Bus module for Spare ICT Connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. One (1) number 1-Phase, single pole operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number, single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall)

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

v. End Piece (Interface) module with Isolating test link for Future extension **on one side** of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi) GIS Auxiliary Bus module Extension for Spare ICT connection (For 400kV side of 765/400kV ICT):

Set of isolated phases, SF6 gas-insulated metal enclosed Auxiliary bus bars module for ICT bays, each set comprising of the following:

i. One (1) number 1-Phase, Auxiliary bus bar enclosure running across the length of the switch gear to inter-connect the spare unit of ICT with all ICT bay Modules through GIS Duct and provision of extension for future ICT.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc. as required.

iii. Extension piece (Interface) module, as required to extend existing Auxiliary bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) module with the Isolating test link for Future extension (on one side) of Auxiliary Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.

vii) GIS ICT bay module (For 400kV HV side of 400/220kV ICT):

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

viii) GIS Bus Coupler Bay module:

SF6 gas-insulated metal enclosed Bus Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

ix) GIS Bus Reactor Bay module:

SF6 gas-insulated metal enclosed Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Three (3) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii. Local Control Cubicle.

x) GIS Line reactor bay module:

SF6 gas insulated metal enclosed Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

ii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

iv. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

v. Local Control cubicle (if required separately).

xi) GIS Switchable Line reactor bay module:

SF6 gas insulated metal enclosed switchable Line reactor bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker without PIR, complete with operating mechanism.

ii. One (1) number 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phases, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers single phase, SF6 ducts inside the GIS hall (up to the outer edge of the wall of GIS Hall).

v. Gas monitoring devices, barriers, pressure switches, UHF PD sensors, support structures etc., as required.

vi. Local Control cubicle.

xii) GIS Bus Section Module:

SF6 gas-insulated metal enclosed Bus Sectionaliser Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker without PIR, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 3-core, multi ratio, current transformers (CTA) on one side of circuit breaker.

iii. Three (3) numbers 1-phase, 2-core, multi ratio, current transformers (CTB) on other side of circuit breaker.

iv. Two (2) numbers 3-phase, single pole, group operated isolator switches, complete with manual and motor driven operating mechanisms.

v. Two (2) numbers 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

vi. Three (3) numbers single phase, SF6 ducts for interconnection of above mentioned elements.

vii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, Support structures etc., as required.

viii. Local Control Cubicle

245 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

3-single (isolated) phase/Three phase enclosed, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Three (3) numbers single(isolated) phase / One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. One (1) number 3-phase, single pole, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

iii. Three (3) numbers 1-phase Potential Transformers, complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link.End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. Three (3) numbers single(isolated) phase / One (1) number three phase, SF6 ducts (as required) inside GIS hall

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of 3-single (isolated) phase/Three phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. Bus bars enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension (on one side) of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. Three (3) numbers single(isolated) phase / One (1) number three phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line Bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v One (1) number 3-phase, group operated high speed fault making grounding switch, complete with manual and motor driven operating mechanisms.

vi Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall)

vii Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

viii Local Control Cubicle.

iv) GIS ICT bay module:

SF6 gas-insulated metal enclosed ICT bay module each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

v) GIS Bus Coupler Bay module:

SF6 gas-insulated metal enclosed Bus Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vi. Local Control Cubicle.

vi) GIS Bus Section Bay module:

SF6 gas-insulated metal enclosed Bus Section Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three (3) numbers single phase(isolated) / One (1) number three phase , SF6 ducts for interconnection of above mentioned elements.

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

vii) GIS Reactor Bay module:

SF6 gas-insulated metal enclosed Reactor Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 insulated circuit breaker complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. Three nos. 1-phase (isolated)/one no. 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, UHF PD Sensors, support structures etc. as required.

vii. Local Control Cubicle.

145 kV Gas Insulated Switchgear (Double Main Busbar Scheme)

The SF6 gas insulated switchgear (50 Hz) shall be of the indoor metal-enclosed type, comprising of following modules:

i) GIS Bus bar Module:

Sets of three phase enclosed, SF6 gas-insulated metal enclosed Bus Bar modules, each set comprising of the following:

i. One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double main bus bar system.

ii. One (1) number 3-phase, group operated safety grounding switch, complete with manual and motor driven operating mechanisms.

iii. One (1) number 3-phase inductive potential transformers, complete with manual operated isolating Switch/device.

iv. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

v. End Piece (Interface) modules with isolating test link for Future extension **on one side** of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

> Project Specific Requirement: Requirement of End Piece (Interface) module with isolating test link **on both side** of Bus bar module shall be considered based upon GIS Layout as and when specified under Section-Project.

vi. One (1) number three phase, SF6 ducts (as required) inside GIS hall.

vii. Local control cubicle (if required separately).

ii) GIS Bus bar Module Extension (Make of Existing GIS: As per Section-Project):

Extension of Three phase, SF6 gas-insulated metal enclosed bus bar module, each set comprising of the following:

i. One (1) number three phase Bus bar enclosures running across the length of the switchgear to interconnect each of the bay modules in Double Main Bus bar system.

ii. Gas monitoring devices, barriers, pressure switches, support structure etc. as required.

iii. Extension piece (Interface) module, as required to extend existing bus to maintain minimum possible inter connection space between GIS supplied under present scope and the GIS being extended.

iv. End Piece (Interface) modules with the isolating test link for Future extension (on one side) of Bus bar module. The end piece module shall be designed in such a way so that future GIS module may be tested without extending voltage to existing bus by removing the test link. End piece interface module for both the buses shall be in one alignment.

v. One (1) number three phase, SF6 ducts (as required) inside GIS hall.

iii) GIS Line bay module:

SF6 gas-insulated metal enclosed Line feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches complete with manual and motor driven operating mechanisms.

iv. Two (2) numbers 3-phase, group operated safety grounding switches, complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase, high speed fault making grounding switch, complete with group operated manual and motor driven operating mechanisms.

vi. One (1) number 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vii. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

viii. Local Bay control cubicle.

iv) GIS ICT bay module:

SF6 gas-insulated metal enclosed ICT feeder bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Three (3) numbers 3-phase, group operated isolator switches complete with manual and motor driven operating mechanisms.

iv. Three (3) numbers 3-phase, group operated safety grounding switches complete with manual and motor driven operating mechanisms.

v. One (1) number 3-phase SF6 ducts inside GIS hall (upto the outer edge of the wall of GIS Hall).

vi. Gas monitoring devices, barriers, pressure switches, support structures etc. as required.

vii. Local Bay control cubicle.

v) GIS Bus Coupler Bay Module:

SF6 gas-insulated metal enclosed Bus-Coupler Bay module, each set comprising of the following:

i. One (1) number 3-phase, SF6 gas insulated circuit breaker, complete with operating mechanism.

ii. Three (3) numbers 1-phase, 5-core, multi ratio, current transformers.

iii. Two (2) numbers 3-phase, group operated isolator switches, complete with manual and motor driven operating mechanisms.